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Don't worry about overhead– it is cost per piece that counts

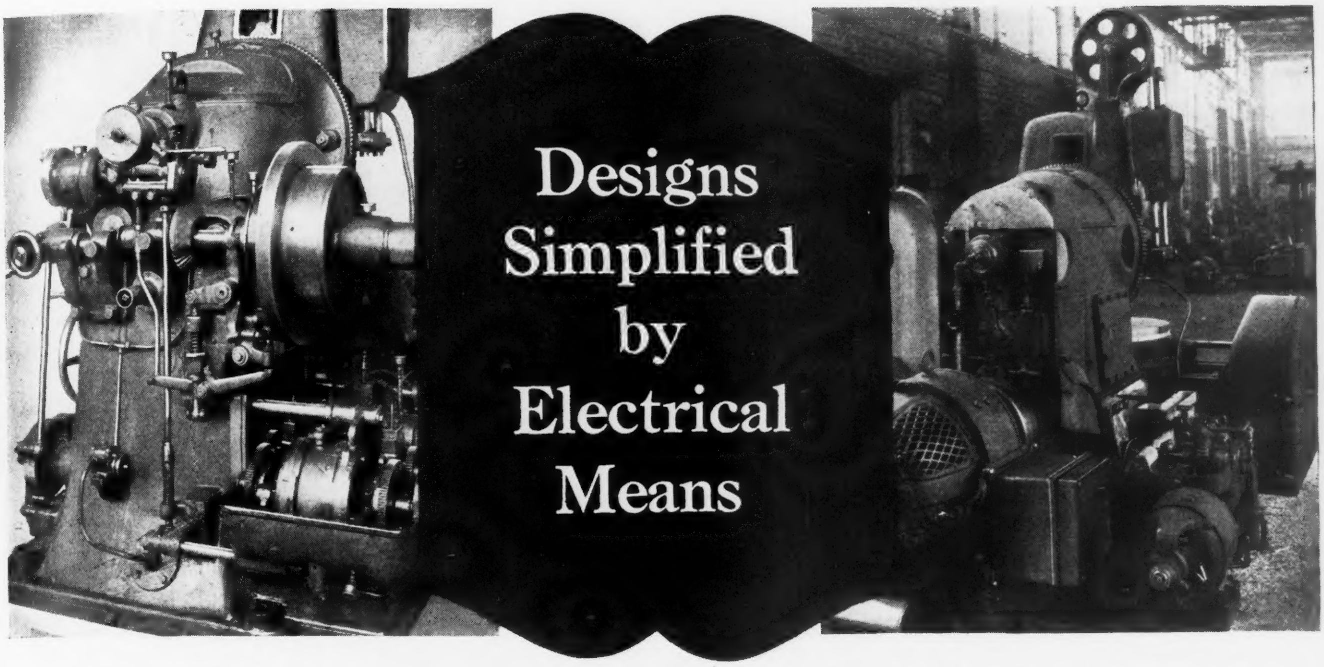
In one of the plants of a very successful manufacturing company, doing a business of considerably more than $50,000,000 annually, the writer mentioned to the manager the tendency in manufacturing plants constantly to increase overhead costs. He smiled and said, "Overhead costs have never worried me—what I am constantly watching is the production cost per piece. If I reduce that cost enough, the overhead will take care of itself."

He then continued:—"The vice-president in charge of our manufacturing recently found that the overhead of one department of this plant had increased from $3000 to $16,000 a year, and the works manager was called upon for explanations, as the output of that department was only 20 per cent greater than last year."

Answered the works manager: "We have put in entirely new machine tool equipment in that department, and it is the interest and depreciation charges against that equipment that have increased the overhead; but you have overlooked the fact that this new equipment saves the labor of twelve men whose combined wages last year amounted to $22,400. Your $13,000 increase in overhead is netting you, on wage savings alone, $9400 pure velvet. The cost per piece has been reduced from 32.8 cents to 23.4 cents, or just about 30 per cent. I also saved half the floor space in that department, which made it possible for us to increase the capacity of the stamping shop."

"Have I justified increasing the overhead?" asked the works manager. "You have," said the vice-president in charge of production, "and I only wish that the managers of all our other plants would keep in touch with new improvements in shop equipment so that they could increase overhead and save money as you have done."

Take a careful look over your plant, and see if this applies.



Designs Simplified by Electrical Means

Some Examples of the Simplification of Machinery by the Use of Motor Drives and Electrical Controlling Apparatus—First of Two Articles

By H. L. BLOOD, Chief of Machine Design Division, Western Electric Co., Inc.

MODERN motors and controllers have been developed so thoroughly and have proved so reliable in service that there is a strong and growing tendency to use electrical equipment for many purposes for which mechanical means were formerly employed. In designing machinery, it is frequently possible, by taking advantage of the electrical equipment now available, to reduce the number of shafts, bearings, gears, clutches, brakes, and other parts, thus making the machine simpler, cheaper, safer, easier to maintain, more convenient to control, and more productive.

A number of examples will be given of machines that have been simplified by the application of electric drives and controls. Although many of these examples show applications of electrical equipment that are somewhat out of the ordinary, they will serve, nevertheless, to illustrate certain general principles that may be utilized in the design of electrically driven machinery. These examples indicate the value to a machine designer of a thorough knowledge of the various types of motors and controllers.

Use of Six Motors for Driving a Machine

It is not at all unusual for a number of motors to be used for driving one machine. It may be thought at first that the cost of the motors would be an important consideration in a case of this kind, but the cost of the motors is comparatively low, because of the large quantities in which they are manufactured. If the use of an extra motor results in the saving of only a very few gears and bearings, it will often be found that the motor costs less than the parts it replaces.

Every competent designer of machines or other mechanical devices aims to simplify all designs as far as possible, without interfering with the functioning or reducing the efficiency of the mechanism. The applications of motor drives and various forms of electrical controlling apparatus have, in many instances, served to accomplish results not practicable by purely mechanical means; moreover, the design frequently is simplified, thus reducing manufacturing costs. This article and a second installment to be published in April MACHINERY contain some specific examples showing what has been done by the substitution of electrical for mechanical drives and controls.

An example of a machine that is very much simplified by the use of a number of motors is shown in Fig. 1. This machine was designed and built by the Western Electric Co. for drilling and sawing off small wooden blocks that form the heads of telephone induction coils. This machine, is entirely automatic, and consists essentially of four high-speed drill heads and one saw head, mounted on suitable slides. Three of the drilling heads are shown at *A*, *B*, and *C*, the fourth being hidden behind head *B*. The saw head is shown at *D*.

Each of these heads includes a "built in" induction motor, the rotor of which is mounted on the drill spindle or saw arbor just as a pulley would be; the stator is slipped into a hole bored in the head casting. All the heads are moved toward and away from the work twenty times a minute by means of suitable cams which are driven by a sixth motor. Because of the reciprocating motion of the heads, it would complicate the machine considerably to drive the heads by purely mechanical means, but by building a motor into each of the heads the problem of driving them has been solved very simply.

The motors in the machine just described run at approximately 7000 revolutions per minute, and for this reason must be supplied with 120-cycle alternating current, which is secured by means of a frequency changer. This is a very convenient way of obtaining speeds higher than 3600 revolutions per minute, and is in common use in connection with woodworking machinery. There are also special motors on the market that run at approximately 7000 revolutions per minute when connected to the regular 60-cycle line.

Use of Adjustable-speed Direct-current Motor

Probably the simplest method of obtaining changes in speed is by means of an adjustable-speed direct-current motor. A good illustration is a veneer lathe, the function of which is to shave a thin sheet of celluloid from a cylindrical block. It is highly desirable to keep the cutting speed constant as the diameter of the block is reduced. This is accomplished in a very simple manner by means of an adjustable-speed direct-current motor which drives the spindle through a worm and gear. The motor is controlled by a field rheostat, which is connected to the cross-slide, or knife-holder, by a rack and pinion, so that as the slide approaches the center, it turns the rheostat, gradually increasing the speed of the motor and maintaining a uniform surface speed. As a result, the output of the machine is approximately twice what it would be if a constant-speed alternating-current motor were used.

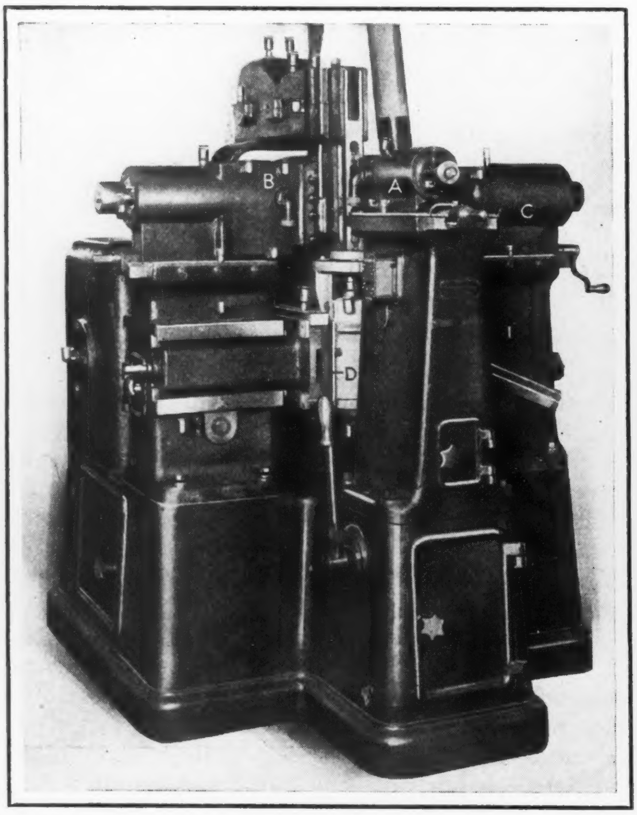


Fig. 1. Special Machine Driven by Six Motors to Simplify the Design

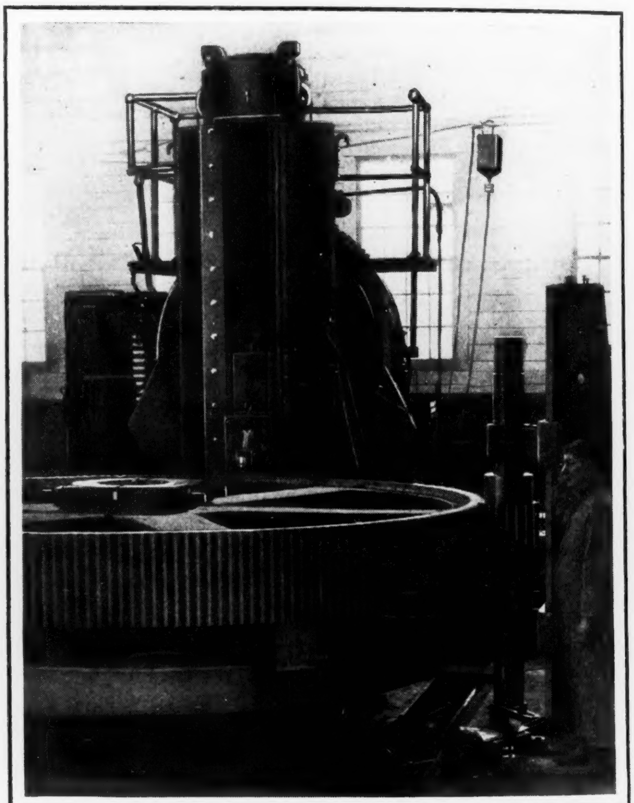


Fig. 2. Gear-cutting Machine with Motor Drive for Ram and Indexing Mechanism

Direct vs. Alternating Current for Shops

It is interesting to note that the factory in which the veneer lathe mentioned in the preceding paragraph is used was originally supplied with alternating current only. One reason for using alternating current was to minimize the transmission losses within the plant, the latter being spread over a large area. It was also felt originally that both the fire hazard and the cost of maintenance would be greater with direct- than with alternating-current equipment. Later, however, it was found that in the case of many types of machinery, these disadvantages were far outweighed by the advantages obtained from the use of direct-current equipment. A direct-current supply, in addition to the alternating-current supply, was therefore provided for driving certain machines, of which the one just described is an example. The use of direct-current adjustable-speed motors has simplified the machines, reduced the maintenance, and, by permitting the use of the proper speeds to suit varying conditions, has increased the output decidedly. In the case of the factory just referred to, the question of fire hazard is unusually important because of the highly inflammable nature of the materials handled. This has not, however, prevented the use of direct current.

In considering the relative advantages of alternating and direct current, it is worthy of note that one of the larger automobile plants has been converted from alternating to direct current. Some idea of the magnitude of this undertaking may be obtained from the fact that some 30,000 direct-current motors were ordered at one time to replace alternating-current motors. As the management of the plant in question is known to be very progressive, there can be no doubt that the advantages to be gained from the use of direct-current equipment must have been sufficiently great to justify the enormous expense of such a change.

It is understood that one reason that direct-current motors were adopted was to make it pos-

sible to change the speed of the machines as often as desired by simply varying the amount of resistance inserted in series with the motor fields. With this provision for obtaining small changes in speed, it is easy to determine and use the proper speed for a given set of conditions and to change the speed as soon as conditions change. The machine may be run slowly to suit the needs of a new operator and the speed increased by degrees as the operator becomes more skillful. The number of factories using direct current is very large. In the electrical industry, for instance, practically all the larger factories producing motors, controllers, and other electrical equipment are operated principally on direct current.

Example of Simplified Design

An idea of the number of parts that can sometimes be eliminated from a machine when it is driven and controlled electrically may be obtained by comparing the two views in the heading illustration. The machines shown are gear shapers; the one shown at the left is arranged for belt drive and the one at the right is the same machine redesigned for direct-current motor drive. The contrast between the two machines is even more striking than is indicated in the illustrations, because many parts of the belt-driven machine (such as speed-change gears, bearings, levers, and clutches) are not visible.

In this type of gear shaper, the gear teeth are generated by a rack-shaped cutter which is moved up and down by a ram, the work being clamped to a circular table and rolled past the cutter. After the table has rolled a short distance, the ram is automatically stopped at the top of its stroke, the table is indexed, and the ram is started again. The stopping and starting of the ram are accomplished, in the case of the belt-driven machine, by a clutch and brake, which require a complex mechanism to actuate them at the exact time when the table and the ram have both reached the proper positions. On the motor-driven machine, the stopping and starting of the ram is accomplished by two contacts, one of which is opened when the table reaches the proper position, and the other when the ram approaches the top of its stroke. When both contacts are open at the same time, the motor is stopped by a magnetic controller of the dynamic braking type.

It was found that the clutches and brakes on the belt-driven machines required the constant attention of an experienced man to keep them in good condition and properly adjusted. Even then the ram would sometimes stop too soon or too late, and the tool would strike the work during the indexing period, breaking the tool and spoiling the work.

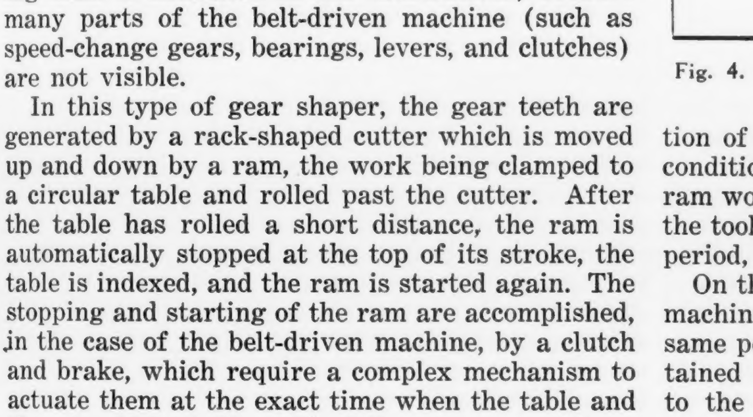


Fig. 3. **Diagram Showing Application of Auxiliary Motor-driven Screw for Preventing Backlash**

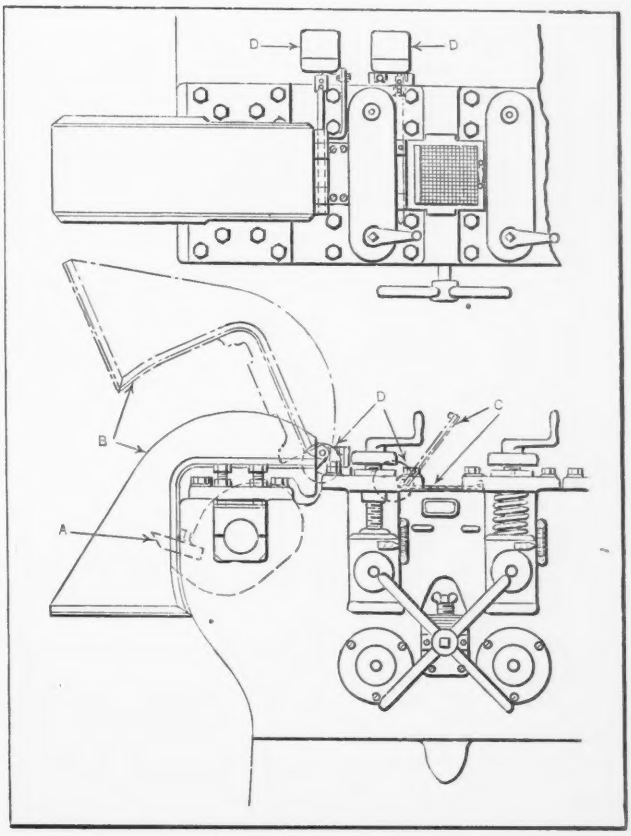


Fig. 4. **Motor-driven Machine Equipped with Automatic Safeguards**

On the other hand, the rams of the motor-driven machine always came to rest at very nearly the same point, and this result was secured and maintained without any special attention being given to the machine after the first setting had been made. The time for stopping the ram in this case did not depend upon adjustments nor upon varying coefficients of friction, but was determined by fixed electrical values and was, therefore, practically constant.

The electrically controlled machines were not only better than the previous design, but much cheaper as well, the electrical equipment being standard and relatively inexpensive as compared with the mechanical parts that it replaced. The advantages of electrical control proved to be great enough to justify the conversion of a large number of belt-driven machines to motor drive by removing pulleys, clutches, brakes, and the mechanism for operating these parts and attaching the necessary electrical equipment.

Motor-driven Screw for Eliminating Backlash

Electric motors may sometimes be used to advantage for taking up backlash in machines. An example of this is shown in Fig. 3, which is a diagrammatic sketch of a work-table for a gear generating machine of the type just described. The circular table *A*, to which the work is clamped,

is carried by a slide *B*. The slide is moved along the bed by an accurate screw *C*, and the table is turned by a worm *D* which meshes with a worm-gear attached to the circular table. The result of these two motions is to give the gear blank a rolling movement by which the teeth are generated.

A certain amount of backlash between the screw and its nut and between the worm and worm-gear is, of course, inevitable. To take up this backlash, a secondary screw or worm *E* is provided, which meshes with the teeth of the table worm-gear and is driven by a small "torque motor" *F*. The motor is connected across the line in series with sufficient resistance so that it may stall or remain stationary without damage, when there is no movement of the table.

Under these conditions the torque exerted by the motor on screw *E* causes the table to rotate and the slide to advance until all backlash is taken up, further movement of the table and slide being prevented by worm *D* and screw *C*. Turning of this worm and screw permits the table to be revolved and the slide to be moved along the bed. When it is desired to reverse the motion of the slide and table, the connections of the motor are first changed so that it will exert torque in the opposite direction. Instead of meshing with the worm-gear, the screw *E* may be connected to the slide by means of a nut, in which case only the backlash between screw *C* and its nut would be taken up.

Motor Drive for Indexing Mechanism

Fig. 2 illustrates a large gear generating machine operating on the same general principles as the gear shapers which have just been described. The ram, in this case, is reciprocated by a screw, which is geared directly to a reversing planer motor. The motor, which is controlled by a standard planer controller, runs at high speed during the up stroke of the ram, is reversed quickly, and runs at a lower speed while driving the ram downward on the cutting stroke. The cutting speed may be regulated as desired by turning the handle of a rheostat in the controller.

The most unusual feature of the machine from the electrical standpoint is the indexing mechanism, which is driven by a small direct-current motor. When it is time to index the table, a pin is withdrawn from the indexing plate and a contact is made in the main controller, which starts the indexing motor. The motor turns the index-plate through one revolution. Just before the revolution is completed, a contactor disconnects the indexing motor from the line and connects it to a small generator which supplies current at a pressure of several volts. When the indexing motor is connected to the low voltage, it slows down immediately and turns the index-plate at a very low speed until the indexing pin drops into a slot in the plate, stalling the motor. With this arrangement the table is indexed quickly and without jar, and the indexing mechanism is firmly locked.

Motor Drive Permits Use of Simple Safeguards

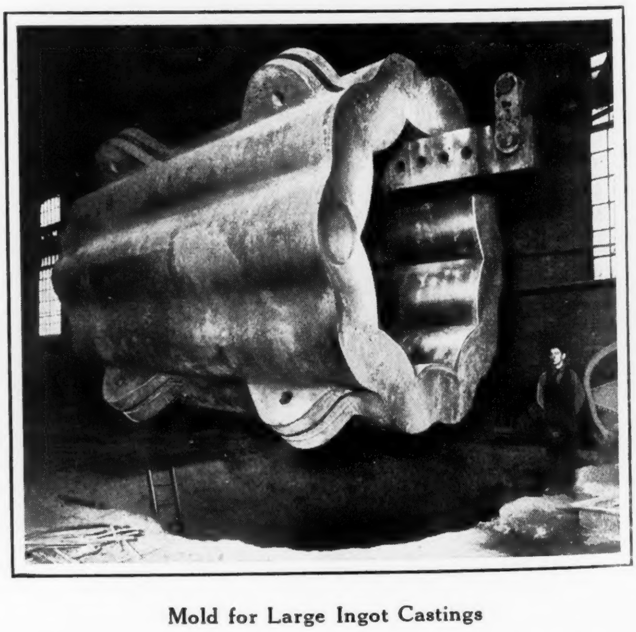
An electrical safeguard, applied to a machine for cutting up scrap telephone cable, is illustrated in Fig. 4. The cable is cut by a rotating knife *A*, which is enclosed by two guards *B* and *C*. As it is sometimes necessary for the operator to reach inside the machine to clean or adjust the knife, the guards are hinged so that they may be swung up out of the way when necessary. Instead of depending upon the operator to stop the machine before raising the guards, it was decided to make it impossible for the machine to run with either of the guards open. This was accomplished by coupling a small drum switch *D* to the hinge pin of each guard so that the first upward movement of the guard would turn the switch, opening the control circuit of the automatic starting compensator and making it impossible for the machine to run. There is no danger of the machine starting unexpectedly when the guards are lowered, because the compensator is provided with under-voltage protection, making it impossible to start except by pressing the "start" button. An emergency stop-button is provided at each end of the machine so that the operator can stop the machine quickly from any position. One of the strongest arguments for individual motor drive is that it permits the use of safeguards of this kind, which are simple, positive, and easily applied, and which cannot be removed or made ineffective by the operator, a requirement that should be given more consideration in applying safety devices than is usually done.

* * *

INGOT MOLD OF UNUSUAL SIZE

An extraordinarily large ingot mold for casting ingots to be used in making large forgings is shown in the accompanying illustration. This mold has just been completed and put in service at the Bethlehem, Pa., plant of the Bethlehem Steel Co. The ingot mold casting, as poured, weighed 387,590 pounds, with a finished weight, after cleaning and removing the sink-head, of 382,000 pounds or 191 tons.

The length of the casting is 15 feet 6 inches, the width across the corrugations at the top of the mold, 9 feet, and the width measured across the concave portions of the corrugations, 8 feet. The weight of the ingot produced in this mold, including the sink-head, is 247 tons.



Mold for Large Ingot Castings

Incentive Payment Plan for Diversified Work

How Maximum Production is Obtained with Minimum Costs in a Shop Where the Character of the Work Varies Constantly

By EDMUND E. BURKE

MANUFACTURING costs should always be lowest in industrial plants where the product and conditions are well standardized and where incentive payment systems enable the individual worker to increase his earnings according to his ability. In such plants, time studies can be conveniently made of each job, and rules laid down for the payment of incentives on an equitable basis. It is fully as desirable to have incentive payment systems in shops where the product changes constantly, but in shops of this kind it is out of the question to make a time study of each operation, as many of them are never duplicated.

The shop of the Kent-Owens Machine Co., Toledo, Ohio, belongs to the latter class for, with the exception of lines of standard hand- and semi-automatic milling machines which comprise only a small fraction of the plant capacity, the output constantly changes. Bottle-making, ice-scoring, riveting, butter-wrapping, plate-glass grinding, toothbrush drilling, and toothbrush bristle-setting machines represent only a few of the special machines that have been built. A single bottle-making machine of the latest type weighs about 90 tons, and contains over 10,000 parts. The development of an efficient incentive payment plan for this shop seemed a prodigious task at the outset, but the system finally devised for the milling department has been working so satisfactorily that the company proposes to develop similar plans for practically every department of the shop.

While it is acknowledged that the incentive method of paying for work is far superior to the day-rate plan, wherever it can be effectively applied, it has generally been assumed that the incentive method of payment is suitable only in plants manufacturing identical or similar parts in quantity. In tool-rooms and in shops engaged in making a great number of different types of machines and devices, it has been thought that the incentive plan of payment could not be applied. During recent years, however, many attempts have been made to do this, and successful results have been obtained both in tool-room work and in the manufacture of varied products. The present article describes the methods used in one plant where the incentive payment plan has been applied to a diversified line of production. The system has been found to work in such a satisfactory manner in one department that it is now being extended to practically every department of the plant.

Time-setting Charts Based on Elementary Time Studies

For every job sent to the milling department a set-up time, standard time, and allowed time are specified, as may be seen from Fig. 1 of the article "Routing Diversified Work through the Shop," which was published in February MACHINERY. These time allowances are based on hundreds of elementary time studies, which were made on all the steps performed by the machine and man in the ordinary operation of all the milling machines in the plant.

Graphic charts have been made up from these time studies, and by referring to these charts, the time setter or computer can quickly compute the set-up, standard, and allowed time for any job. The manner in which these charts were developed will be explained in an article that is to appear in a later number of MACHINERY. All routing cards are filed for future use when the jobs to which they pertain are completed, and if a similar job happens to run through the shop, the proper times are specified from the original card.

Definitions of Set-up, Standard, Allowed, Actual, and Pay Times

The "set-up" time specified on the routing card equals the total time required by a skilled machinist to set up a machine for a job and tear down the set-up after the job has been completed, multiplied by a factor of 1 2/3. This set-up time is allowed only once for a continuous job, whether one or a large number of pieces are machined.

The "standard" time is the best possible time in which a job can be done by a good man under good conditions and at a sustained rate throughout the day. It is the time set as the mark for each operator to attain, and his pay increases as he reaches and passes that mark. The aim is to so specify standard times that when a man attains a standard time, his earnings per hour equal 1 1/3 times his normal hourly pay. The factor of 1/3 was decided upon after a careful analysis of the wages paid in other shops of the same city, the conditions under which the men work, the grade of men employed, etc.

The "allowed" time is the time set for the beginning of incentive payment. Until a man's performance reaches the allowed time, he is paid his straight hourly wage, but when his "actual" time is lower than the allowed time, he is paid an incentive in addition to his hourly wage. The incentive equals his hourly wage multiplied by the actual time plus one-half the difference between the allowed time and the actual time. In other words, he receives credit for one-half the time saved and the other half of the saving is applied to reducing the cost of the operation.

The "actual" time, of course, is the time actually consumed in the operation. The allowed time is always made 1 2/3 times the standard time. The

"pay" time equals the actual time plus the incentive time.

Importance of Care in Setting "Standard" Time

Care must always be taken in setting the standard time for a job, because if this time is too high, the operator can earn excessive pay without exerting himself. On the other hand, if the standard time is too low, the operator soon realizes the impossibility of earning a fair incentive payment and will reduce his efforts. In neither case can there be the attainment of maximum production with lowest costs, even though some saving may be effected over the costs obtained with a straight hourly payment rate.

Assume that when a straight day wage is paid, ten hours time is considered good performance for a certain job, but that with a proper incentive the job can be completed in six hours. To attain six-hour performance, it will be necessary to pay an incentive of say one hour, making the pay time seven hours. In order to divide the time saved equally between the employe and the company, it is necessary to set an allowed time of eight hours. If an allowed time of, say, three hours were set for this job, the operator, having a conception of the job ordinarily requiring ten hours, would not only ignore the absurdly low time, but might even deliberately stretch the job to eleven or twelve hours. If an allowed time of twelve hours were set, the operator might do the job in six hours and receive a pay time of nine hours. It is thus imperative to decide carefully what is the best time to be specified as the standard for each operation. Basically and economically, it is wrong to set times for incentive payment on any principle other than the best possible performance.

How a Man's Pay is Calculated

In order to illustrate the manner in which a man's pay is determined for a given job, reference will again be made to the article published in February MACHINERY. From the routing card shown in Fig. 1, it will be seen that 36 minutes is allowed for setting up the machine for the second operation and for tearing down the set-up when the job has been completed. The standard time per piece is 29.3 minutes, and the allowed time per piece, 49 minutes. It will be understood that the total allowed time for twelve pieces amounts to 36 minutes plus 12 times 49 minutes or 10.4 hours.

From the time card illustrated in Fig. 4 of the previous article, it will be seen that operator No. 417 completed the job after working 1217 minus 1175 or 42 periods of 0.1 hour, on September 25th. These periods represent 4.2 actual hours for that day, but as the operator worked 2.2 hours on the same job on a previous day, the total actual time consumed on the job is 6.4 hours. To find the number of premium hours for which the man is to be paid, it is simply necessary to divide the difference between 10.4 and 6.4 by 2, which gives 2 hours. Adding this sum to the number of actual hours gives 6.2 hours as the pay time to be credited to the man. The hourly wage of this man is multiplied by the pay hours to determine his compensation for the job. Assuming that the man receives 60 cents per hour, his pay for the job amounts to 6.2 times 60 cents or $3.72. For overtime work, 1.5 times the standard hourly wage is applied to the actual hours.

In the space "Burden Rate," is marked the overhead per hour chargeable to the machine on which the operation is performed, and the actual sum to be charged to the job is written in the space "Burden Amount." This amount is determined, of course, by multiplying the burden rate by the actual hours consumed in the operation.

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RUSSIAN CATALOGUE OF AMERICAN MACHINERY AND EQUIPMENT

A large volume entitled "Catalogue of American Industry and Trade," printed entirely in the Russian language, has been compiled and published by the Amtorg Trading Corporation, 165 Broadway, New York City. This catalogue is to be placed in the hands of business and trade executives, important purchasing agents, and engineers and professors in the Soviet Union. The volume contains 1076 pages, 9 by 12 inches, and is provided with 2800 illustrations. In conjunction with the publication of this catalogue of American machinery and equipment, it is stated that the total value of the trade between America and the Soviet Union in the last two years has amounted to $200,000,000, or more than double the pre-war average.

Most of the leading American manufacturing concerns are represented in the pages of the catalogue, of which 5000 copies have just been shipped to the Soviet Union. Seven thousand products are listed in its index, and the names of 45,000 firms and corporations are given.

In addition to the purely commercial information, a section of the volume contains twenty-eight articles written by qualified engineers and technical men, covering various phases of American engineering and manufacturing developments. One-half of these articles are devoted to the electrical field, which is significant in connection with the Soviet Union's ambitious program of super-power development; this includes the constructing, beginning this spring, on the Dnieper River, of the largest hydro-electric development in Europe. Fifty pages are devoted to an economic survey of the United States, with maps. To this is appended a descriptive list of scientific and research organizations, with their principal publications.

* * *

CENTRIFUGAL CASTING OF STEEL

A paper dealing with the casting of steel by the centrifugal method was presented at the winter sectional meeting of the American Society for Steel Treating at Washington, D. C., January 20 and 21. In this paper, the author, Leon Cammen, dealt first with the more familiar subject of centrifugal tube casting, showing its present and prospective field of application and its limitations. In the second part of the paper, the author described the new art of centrifugal bar casting, which it is claimed, when perfected, will aid in producing metal of better quality and at a lower cost per ton than is possible by present methods. The machinery employed for this process was also described.

Forming Dies for a Tapered Tube

By EDWARD HELLER

Edward Heller was born in Russia in 1889. At the age of thirteen, he was apprenticed for three years in a machine shop. In 1905, he came to the United States and worked until 1916 as a machinist, toolmaker, and diemaker. Meanwhile, he went to evening school, covering the work of the elementary grades and a high-school course in six years. He then entered Cooper Union, New York City, from which he graduated in 1916, after five years of evening study, with the degree of Bachelor of Science in mechanical engineering. Later he studied electrical engineering at Cooper Union. He is now engaged in designing tools, dies, and fixtures.

THE automobile torque tube *A*, Fig. 1, was made from a blank of the shape shown at *B*. It was formed in two operations, and welded at the seam, as indicated. The design of the tools used for this work and the methods employed in making them will be described in this article.

In Fig. 2 is shown the first forming die. It consists principally of three parts—the shoe *S*, a machine-steel filler *D*, and the tool-steel form blocks *H*. Longitudinally, the die is made up of three sections, the ends *A* and *B* being parallel, while the center part is tapered. From the dimensions of the tube, was calculated the exact width at *E* and *F*. The filler was then machined to the required size. Next, the die was divided into convenient lengths *H*, and the radius of the form blocks at each end was carefully calculated.

Making Die-blocks for Tapered Section

Fig. 3 shows the method used in making the tool-steel blocks. All the blocks were machined to the same rectangular dimension and to the required length. They were then put together in pairs on an angle-plate in the lathe, and trued up for boring, care being taken to see that the joint at *A* was on center.

A taper hole that corresponded with the calculated diameters was next bored out. Of course, the greatest part of the stock was first removed on a shaper, so that a very small amount of metal had to be bored out on the lathe. This operation was repeated for each pair of blocks, and when they were all put together, they formed a continuous tapered semicircular surface. The end blocks, of course, were the simplest to make, because they were cylindrical.

In Fig. 4 is shown a typical section of the punch made up of the tool-steel form blocks *A*, the filler *B*, and the punch-holder *C*. The plan view of the filler *B* was practically the same shape as the filler in the die. It also tapered vertically, the same as the die filler. The only difference was in the thickness *D* and the over-all length. It had to be shortened on one end, to allow it to clear the gage pin in the die.

Turning Blocks for Forming Punch

Fig. 5 shows the method used in turning the punch form blocks. The

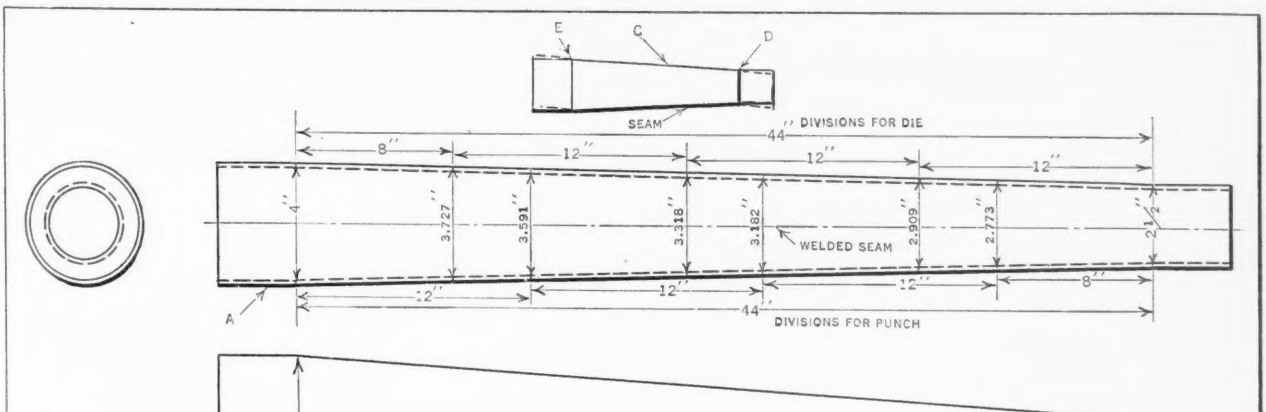


Fig. 1. Automobile Torque Tube for which the Forming Dies Shown in Figs. 2 and 6 were Designed

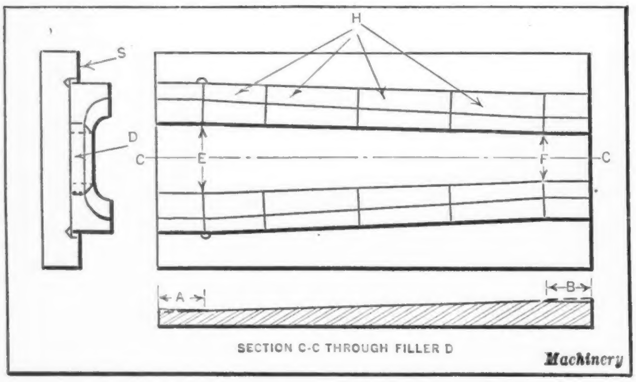


Fig. 2. First Forming Die for Part Shown in Fig. 1

tool-steel blocks *A* were machined square at *B*, and finished a little longer than required. They were then fastened to a machine-steel plate *C* with screws and dowels, after which the entire unit was centered and turned and faced to the proper diameter, taper and length. As in the case of the die-blocks, the finished punch-blocks, when put together end to end, formed a continuous half of a frustum of a cone. The screw and dowel holes were later used to fasten the block to the punch-holder.

Fig. 6 shows a typical section of the second or final forming die. The construction of this die was very simple, as it was all circular work. At *A* is shown the work as it comes from the first form die. Two or more supports *B* are fastened to the lower member of this tool to support the semi-finished job. The upper member is cut away at *C* to clear the supports *B*. With the exception of

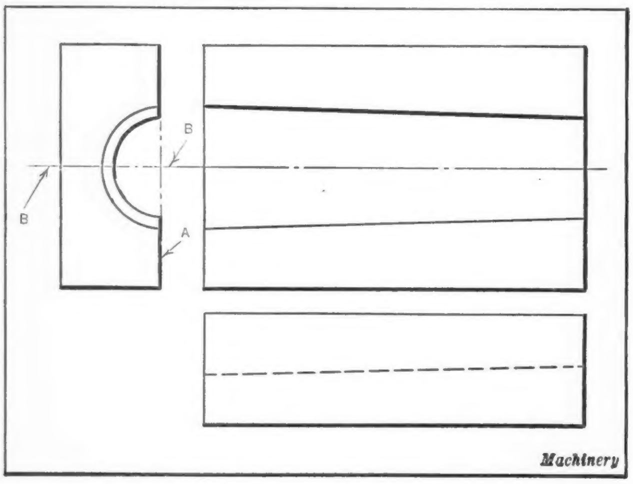


Fig. 3. Corner Sections of Die for Torque Tube

these two points, the upper and lower members of this tool are alike.

This method of making a tube is much better than the ordinary method of first bending it to a U-shape and then closing it over an arbor. The latter shaping method always leaves the ends somewhat flat. With the method described here, the ends are bent first, and so can be struck home hard enough to shape them properly. In the second operation, the work coils around the die gracefully. It usually slips a little more in one member than the other, so that it always ends up with the seam inside of the die away from the joint faces *D*.

After a number of these tubes were made, a defect was discovered, which at first looked like a puzzle, but it was eventually analyzed and corrected. At *C* in Fig. 1, the trouble is shown in exaggerated form by the dotted lines. The cylindrical ends of the tube did not come parallel with the taper section, the small end being bent down toward the seam, while the large end was bent away from the seam. After considerable thought, the trouble was discovered to be in the shape of the blank. However, it was of a nature that could not be easily remedied. Fig. 7 shows in an exaggerated way where the trouble was.

Difficulty in Shaping Tube

Theoretically, a tube of the required shape cannot be made from a one-piece blank. The blank consists of a rectangle *ABCDE*, Fig. 7, a sector of a ring *CFEGHI*, and a rectangle *IJGKL*. In the blank from which the tube was formed, there is

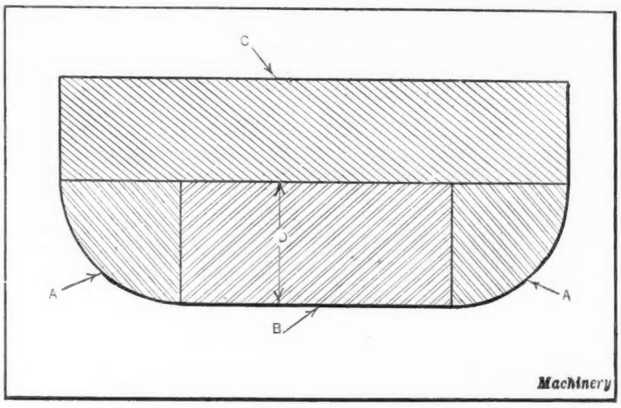


Fig. 4. Cross-section of Punch Used with Die for Forming Torque Tube

an excess segment of metal *CDEF* at the small end, while at the large end, there is a shortage of metal, as indicated by the darkened segment *IJGH*. The result was as shown at *C*, Fig. 1. The small end *D*, where there was a surplus of metal, bent down, while the large end *E*, where there was a shortage of metal, bent up.

The remedy for that was to distort the first forming die, to give the metal a "set" in the first operation; hence, the parallel portions *A* and *B* in Fig. 2 were machined to a slight angle, making one end lower and the other end higher. From then on, the die worked satisfactorily.

This operation was performed in a very efficient manner. The three dies for the tube were made to exactly the same shut height. This made it possible to put them all on one large press. The sheared strips were brought to the blanking die; from there the blank was slid over to the first form and finally to the last forming die. After the third

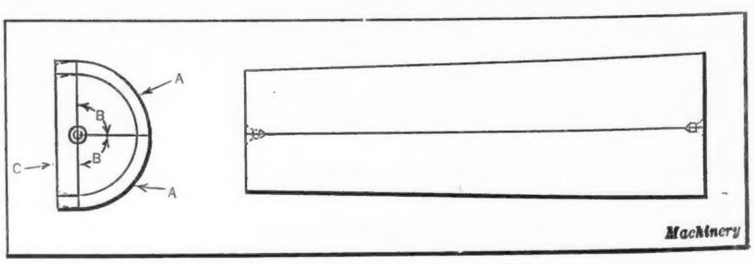


Fig. 5. Turned Corner Sections of Punch

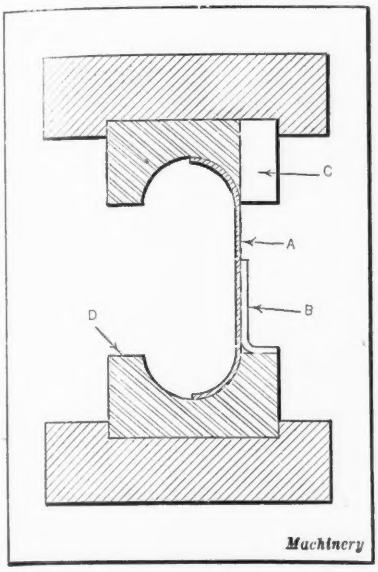


Fig. 6. Typical Section of Final Forming Die

stroke, each stroke of the press produced a complete tube.

Calculations for Toolmaker

It might be interesting to go through the calculations that were used in this job. All figures used in the calculations are shown in Fig. 1. To avoid fractions as much as possible, we will assume the nearest whole numbers for our dimensions, also even dimensions for the neutral diameter of the extreme ends of the tube, namely, 4 inches and 2 1/2 inches, respectively, for the large and small end. These figures will give us

$4 \times 3.1416 = 12.566$ circumference at large end and

$2.5 \times 3.1416 = 7.854$ circumference at small end.

This gives us

$$\frac{12.566}{2} = 6.283 \text{ for width } E \text{ in Fig. 2}$$

and

$$\frac{7.854}{2} = 3.927 \text{ for width } F$$

The length of the taper part, which we will assume to be 44 inches, was divided into three equal 12-inch sections and one 8-inch section. For the die, the small section was placed at the left, while for the punch the short section was placed at the right so that the joints did not come together.

The taper in this tube was $\dfrac{4 - 2.5}{44} = 0.03409$ inch per inch.

With this information, the diameter of the tube at the joints was calculated.

Beginning at the right-hand end, the diameter after the first 12-inch length was

$$2.5 + (0.03409 \times 12) = 2.909$$

The diameter at the second joint was

$$2.909 + (0.03409 \times 12) = 3.318, \text{ etc.}$$

The same method was used for getting the diameters of the punch section. The first one from the left end was calculated to be

$$4 - (0.03409 \times 12) = 3.591$$

With the diameter at each end of a set of blocks, together with the taper, the turning or boring operation could be checked very accurately.

POWER TRANSMISSION ASSOCIATION

An organization to promote the most efficient and economical distribution of power has been formed by manufacturers making equipment used in the power transmission field. Among the different branches represented are pulleys, shafting, and general power transmission equipment; hangers; leather, fabric, and rubber belting; belt lacers and accessories. At a recent meeting, W. S. Hays was engaged for the position of executive secretary, by unanimous action of the executive committee. Mr. Hays will have headquarters at 791 Drexel Building, Philadelphia, Pa. Mr. Hays is an electrical engineer—a graduate of the Sheffield Scientific School of Yale University—and has had several years practical experience with the General Electric Co. and other electrical firms in power installation work. He was also connected with the McGraw Publishing Co. previous to the time when the McGraw and Hill interests were merged.

The officers of the Power Transmission Association are as follows: President: W. H. Fisher, secretary of the T. B. Wood Sons Co., Chambersburg, Pa.; vice-presidents: Frank H. Willard, president, Graton & Knight Co., Worcester, Mass.; Benjamin A. Keiley, president, R. & J. Dick Co., Inc., Passaic, N. J.; William R. Simpson, vice-president, the American Pulley Co., Philadelphia, Pa.; S. A. Ellicson, president, Chicago Pulley & Shafting Co., Chicago, Ill.; Wylie K. Lee, president, Clipper Belt Lacer Co., Grand Rapids, Mich.; and E. D. McKown, vice-president, Hans Rees' Sons Co., Inc., New York City; treasurer: L. H. Shingle, president, Shingle-Gibb Leather Co., Philadelphia, Pa.

* * *

DESIGN AND CONSTRUCTION OF TAPS

The leading article in April MACHINERY is the first of a series of eight articles on the design, construction, and use of threading taps—one of the most complete treatises on this subject that has ever been published. The author, A. L. Valentine, manager of the Tap and Gage Division of the SKF Industries, has had thirty years' experience in the manufacture of taps, dies, and other small tools, having been for over fifteen years superintendent of the Small Tool Division of the Pratt & Whitney Co., Hartford, Conn. Mechanical men, whether engaged in making or using taps and threading tools, will be interested in this series.

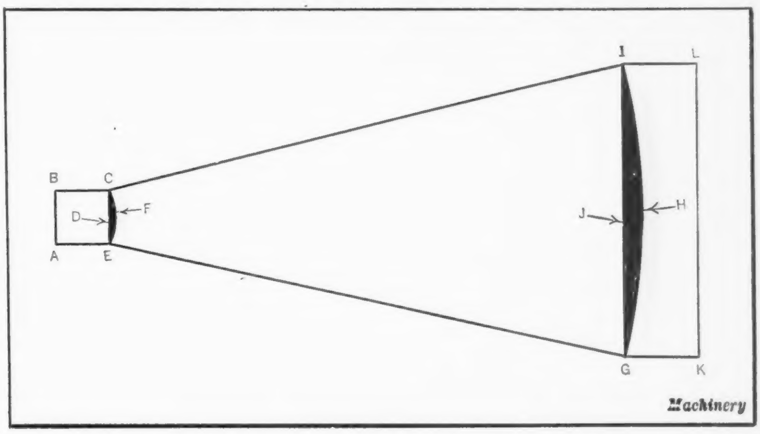


Fig. 7. Diagram Used to Explain Difficulty Experienced in Forming Tube

Wear Resistance of Cutting Edges of Blanking Dies and Shear Blades*

By W. J. MERTEN, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

IT is universally recognized that shearing and blanking of sheet steel covered with hammer or roll scale will dull or wear down the cutting edge of die parts and shear blades and produce a burr sooner than when there is no scale. Hammer scale is an abrasive material, and quite hard, as compared with the hardness of low-carbon steel. It is a sesqui-oxide of iron (Fe_3O_4), and has a mineral hardness of 5.5 to 6.5 on the Mohr scale of hardness, and a specific gravity of 4.9 to 5.2. However, as it is impractical to obtain a scale-free material for economic and commercial reasons, the use of heavy, clinging, or highly adhesive greases as lubricants has been found to practically neutralize the scoring tendency of the scale.

It has also been recognized that the embedding of the crushed crystals of iron-oxide scale and the prevention of their pulverization, spreading, and lodging between the cutting edges is responsible for improved performance. Iron silicide crystals (FeSi) in 4 per cent silicon sheet having a considerably greater abrasive quality than iron scale, affect the cutting edges of tools similarly, and the tendency to dull the edge is very pronounced if a crushing or pulverizing of the crystals takes place and precedes the shearing of the sheet. Evidently, any process or method resulting in a splitting of the iron silicide crystals without powdering or severe fragmentation aids in the retention of a sharp cutting edge and prolongs the life of the die or shear blade.

Methods that Hinder Excessive Crystal Fragmentation

To bring about the splitting of hard crystals of iron oxide or iron silicide, instead of crushing them, is accomplished by various methods:

1. By baking on a coat of lubricating enamel.
2. By inserting a layer of paper on the top of the sheet or between the punch and the sheet.
3. By dipping sheets into a solution of hot copper sulphate ($CnSO_4$) or lead acetate ($PbC_2H_3O_2$), thus depositing a soft metallic coating of copper or lead on the surface.

All these methods have the same object, namely to fill the small surface cavities and lock or embed the exposed hard and brittle particles, thereby preventing their fragmentation or powdering and spreading just prior to subjecting the softer ground mass of the sheet to the shearing stresses. The more secure such embedding or locking is, the greater the life and the better the performance of the cutting edge. Deposits of metallic copper or lead obtained from dipping the sheets in a solution that precipitates these metals on the sheets should give most satisfactory results. This method is not favored, however, on account of the high cost of these materials and the more expensive method of application.

A striking illustration of the effect of brittle crystals rendered weak and fragile by removing from them their supporting matrix, the soft iron, is the low production and rapid dulling of the cutting edge from punching pickled sheets. Pickling acid (H_2SO_4) obviously acts only on the iron matrix, iron silicide being practically acid-proof. The dissolving of the iron naturally exposes the iron silicide crystals still more and weakens their resistance to crushing stresses, and it is practically certain that excessive powdering and spreading takes place before actual shearing of the sheet starts. Consequently a very short production-life was obtained from the dies.

The facts mentioned explain why fluid lubricants, which give merely a wet film, are not successful in solving these problems. A substantial and viscous lubricant is needed to embed and hold the fragments of the split crystals.

Successful Dies and Die Steel Characteristics

The successful performance of a die for large production in blanking operations was at one time (not so long ago) synonymous with the producing of a hard stationary die plate and a soft punch or moving die part of quenched and tempered tool steel. The latter would permit the greatest number of peening or refitting operations without splitting, breaking, or chipping the edge. This practice was quite generally accepted as giving the best results and long die life. With the advent of very hard but tough and highly abrasive-resistant alloy steels, the hard punch and die plate combination has supplanted the old method in all but a few special cases.

The type of steel now most favorably considered for blanking dies and shear blades is the high-carbon high-chromium type of tool steel of the following approximate analysis: Carbon, from 2.00 to 2.25 per cent; chromium, from 10 to 12 per cent. This steel has a scleroscope hardness of from 85 to 95 when oil-quenched from 1800 degrees F. and tempered at 600 degrees F.

Blanking or Outline Dies

The successful application of a hard punch and die plate, or highly and uniformly hard movable and stationary die parts, depends to a large degree upon the rigidity of the punch while blanking. On outline dies or on dies where the entire perimeter of the punch section is used as a cutting edge, the tendency to produce a side thrust is practically nil, and a hard-punch hard-die plate combination will work out ideally.

*Abstract of a paper read before the meeting of the American Society for Steel Treating at Washington, D. C., January 20 and 21.

For dies where the punch cuts on one side of the cross-section only, the soft punch is still employed. Since no clearance can be allowed between punch and die plate, and since a tremendous pressure is exerted upon the cutting side of the punch, a hard punch introduces a grinding effect upon the cutting edge of the die plate or stationary part, producing a burr after comparatively few strokes. The softer punch, naturally having less abrasive action on the cutting edge of the die plate, insures longer life and therefore is favored on dies of this class.

Deformation of Crystal Structure not Evidenced by Burr Formation

There is, however, a very important consideration outside of the producing of a burr caused by dull cutting edges of the die, namely, the crushing of the hard crystals and the plastic flow and deformation of the metal held between and sheared by very hard cutting edges, as compared with the deformation when held between and sheared by cutting edges, one of which is comparatively soft and the other hard. To investigate this difference, if any, a series of blanks were selected. One set was blanked with a newly ground (therefore sharp) soft punch and hard die-plate combination die. Another set was blanked with a newly ground (therefore sharp) hard punch and hard die-plate combination die. The third set was blanked with the dulled edge of the hard punch and hard die-plate die.

It was quite evident that the sharp but soft punch and hard die-plate combination die produced a considerable dragging effect, extending quite a distance into the blank. This type of plastic deformation, because of its depth, did not show this drag in the form of a burr, although its deleterious effect upon the electrical and magnetic characteristics may be as bad or worse than that of a dulled-edge hard punch and hard die-plate combination die, where plastic deformation is concentrated and localized near the edge of the blank, as evidenced by a burr.

The decidedly advantageous results from a hard punch and die-plate die combination, in producing the minimum plastic deformation of the sheared section and the immediate adjacent material were plainly and strikingly apparent.

Summary of Investigation

A summary of the results of the investigation involving wear resistance of cutting edges of blanking dies and shear blades shows that:

1. The application of highly viscous lubricants aids performance and lessens abrasion or dulling of cutting edges by preventing powdering and spreading of hard and abrasive constituent of sheets.

2. Uniformly and fully hard die parts offer many advantages with regard to quality of blank produced and quantity of production; however, the designer is called upon to use his ingenuity in designing an outline die in which the perimeter of the entire cross-section performs during the shearing of the blank, without excessive scrap metal from the sheet.

3. Plastic deformation not evidenced by burr formation is produced by the use of soft punch parts; this deformation may at times be more detrimental than a more localized drag resulting in a burr.

General Conclusions

In concluding, it should be stated that there are obviously other factors outside of those related to tool maintenance, life of die, and quantity production to be considered in a final analysis and solution of the problem of increasing the wear resistance of cutting edges of blanking dies. Some of these are:

1. Better results in the assembly of the blank in the apparatus or machine.
2. Greater uniformity of grain structure of blank due to less deformation in blanking.
3. Lower annealing temperatures for restoration of normal crystal structure.

However, the concluding remarks are of a speculative character and purposely injected to stimulate discussion and further investigations along a line that is of the greatest value to the blanking die manufacturer and stamping and blanking departments of electrical equipment manufacturers, as well as to others who are engaged in blanking die work.

* * *

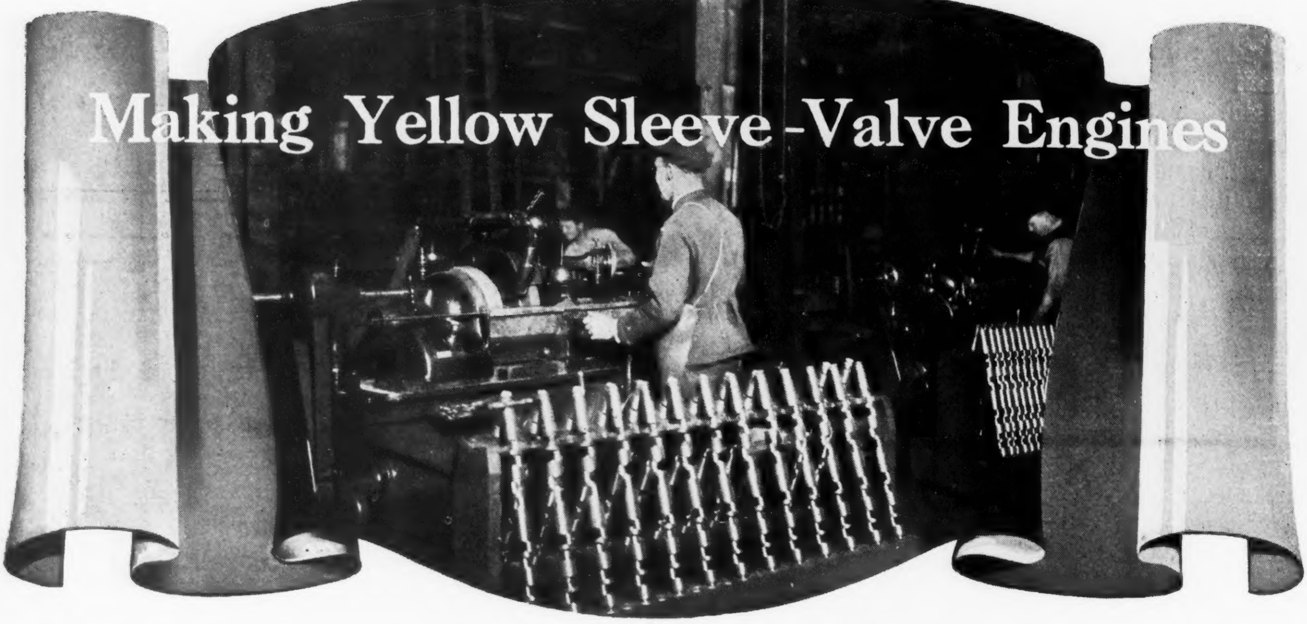
SMALL AIRPLANES NOT COSTLY

At a recent meeting of the Southern California section of the Society of Automotive Engineers held in Los Angeles, W. B. Kinner, president of the Kinner Airplane & Motor Co., mentioned that airplanes having a capacity of from 165 to 330 pounds, in addition to the pilot—that is, designed to carry one or two passengers—can now be purchased at prices ranging from $2500 to $3500. These planes will fly from fifteen to twenty miles per gallon of gasoline. Their total weight is only about 800 pounds, so that they can be handled easily on the ground. They are capable of making a speed of 100 miles an hour.

Such planes have already been found of value in transporting doctors, ranchers, and business men, when distances are too great and time too limited for automobiles to be used advantageously. The western part of the United States, particularly, offers great opportunities for the use of these planes. If airplanes could be produced in quantity, the same as automobiles, the prices for planes of the type described could be greatly reduced.

The Aeronautical Chamber of Commerce states that between 3500 and 5000 airplanes are now in commercial use in the United States. There are about 1000 individuals and companies engaged in aerial service activities. While a regular air transport company usually must be organized on a large scale, with ample capital, it is possible for an aerial service operator to begin operations with a single plane, being himself pilot, manager, and staff. Many such individual service aviators operate from fixed bases in various parts of the country. There is nothing comparable to America's aerial service operators in any country in the world. These operators, with a plane of their own, usually give flying instructions and carry occasional passengers to any required destination.

Making Yellow Sleeve-Valve Engines



Selected Operations in which Quantity Production is Attained Together with Quality

By CHARLES O. HERB

QUANTITY production methods are employed in all automobile plants for manufacturing parts of high quality, but the methods often differ materially. Certain methods in practically every plant could be profitably adopted not only in other automobile factories, but also in shops of different industries as well. This article will deal with selected operations performed on the Knight sleeve-valve coach, cab, and truck engines built by the Yellow Sleeve-Valve Engine Works, Inc., East Moline, Ill.

How the Cylinder Blocks are Milled

Ten cylinder blocks are mounted at one time on the large machine illustrated in Fig. 1 to have the top, bottom, intake, and exhaust sides milled. For finishing these surfaces, each cylinder block must be placed in both sides of double fixtures, five blocks being completed at every reciprocation of the table. The bottom and exhaust sides of the cylinder blocks are milled while the blocks are placed in the first position in the fixtures, and the top and intake sides are milled while the blocks are mounted in the second position. Location of the work in the first position is assured by means of permanent rest-buttons and adjustable plungers, while in the second position, the surfaces that were milled in the first step are located on permanent plates.

The front of this double-rail machine is equipped with a vertical head for milling the exhaust side of the cylinder blocks, a vertical head for rough-milling the top, a horizontal head for rough-milling the bottom, and a two-spindle horizontal head for

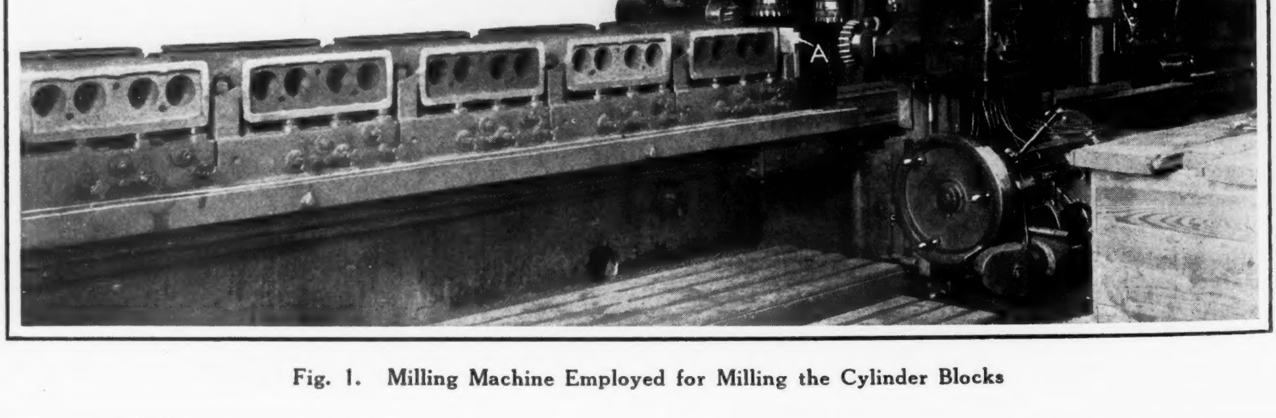


Fig. 1. Milling Machine Employed for Milling the Cylinder Blocks

milling the intake side and four bosses required in connection with the oil rectifier.

The rear of the machine is equipped with a vertical head for finish-milling the top of the cylinder blocks, and a horizontal head for finish-milling the bottom, only one cut being taken on the intake and exhaust sides. All the cutters have hardened steel bodies and inserted blades. Stellite blades are provided for the roughing cuts, and high-speed steel blades for the finishing cuts.

The cutters are readily adjusted to the proper positions by the aid of a permanent set-block *A* which is built into the first fixture. In setting the roughing cutters, a gage 0.275 inch thick is placed on block *A*, and the cutters are adjusted to this gage, while for setting the finishing cutters, a gage 0.250 inch thick is used.

Boring the Cylinder Blocks

All four bores of the cylinder blocks are bored at one time on the machine shown in Fig. 2, which comprises a standard 30-inch lathe equipped with special fixtures and Davis boring-bars. One of the boring-bar spindles is driven direct from the machine spindle through connection *A*, which is of a floating design. The remaining boring-bar spindles are driven from the first through gearing. From each boring-bar spindle, the drive to its respective bar is transmitted through a flexible coupling of the Oldham type.

Each boring-bar is piloted on both sides of the work. The bushings in the left-hand side of the fixture are fitted with keys which slide in keyways in the bars; hence, the bushings revolve in operation, and the large outside surface of the bushings constitutes the bearing surface. The arrangement keeps the bushings and bars in constant relation to each other, and permits the tool-blocks in the bars to pass through slots in the bushings.

Milling Ports in Valve Sleeves

Those familiar with the construction of automobile sleeve-valve engines know that in each cylinder bore there is an inner and an outer sleeve which regulate the admission and expulsion of the gas. The inner sleeve is several inches longer than the outer one. A port hole or slot is milled on each side of both sleeves, and the operation illustrated in Fig. 3 consists of milling these port holes at one time in both inner and outer sleeves.

One port hole in the two sleeves is of the same width, and so these ports are milled by a cutter mounted on the main arbor of the machine. Cutters mounted on outer auxiliary spindles produce the remaining port hole in each sleeve. Both sleeves are slipped over arbors for this operation, the arbors being provided with clearance grooves for the cutters. The sleeves are located radially by means of dowel-pins which enter holes previously drilled in lugs on the sleeves.

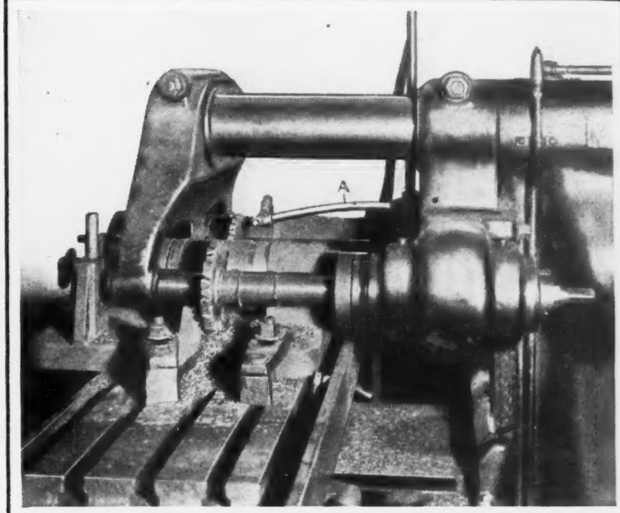


Fig. 3. Milling Both Ports in an Inner and an Outer Valve Sleeve

Assuming that the reader is standing in front of the machine, the table is first traversed toward the right, so that the middle cutter mills the port of the sleeve at the left, and the right-hand cutter mills the sleeve at the right. The table motion is then automatically reversed to bring the right-hand sleeve in contact with the middle cutter and the left-hand sleeve in contact with the left-hand cutter. Since the middle milling cutter does twice the work of the other two, compressed air is directed upon it through jets in pipe *A* so as to keep the temperature of this cutter approximately the same as that of the other two.

Operations on the Valve-sleeve Connecting-rods

Short aluminum connecting-rods, mounted on and actuated by the eccentric shaft, move the valve sleeves of the engine up and down when an engine is in service. Two of these rods may be clearly seen at *X*, Fig. 4. The bolt head and nut seats and the sides of the bolt bosses of the large end, as well as the sides of the small boss, are milled simultaneously on both rods in the automatic milling machine illustrated in Fig. 5. The cuts are taken by sixteen cutters mounted on two arbors. All surfaces machined must pass the inspection of "Go" and "No Go" snap gages.

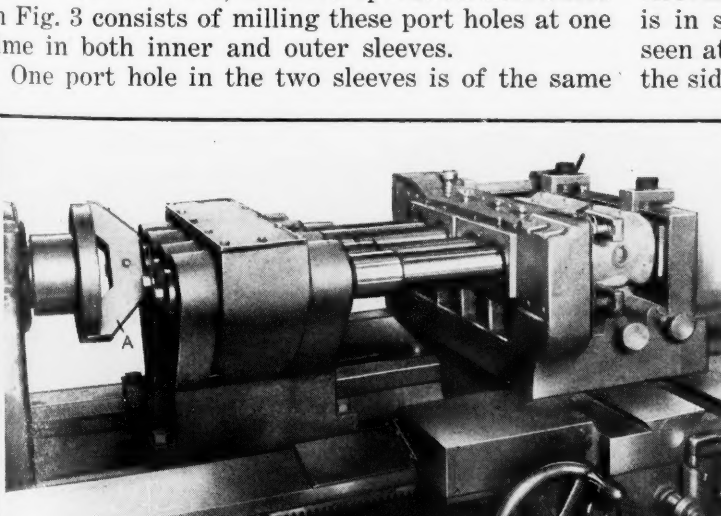


Fig. 2. Simultaneously Boring the Four Bores of Cylinder Blocks

The fixture is of an indexing design, so that one pair of rods may be reloaded while another pair is being milled. Both the large and small boss on each rod are located by means of fingers, and the two rods of each pair are gripped in position by means of an equalizing clamp *A*. After two rods have been placed in position, this clamp is swiveled to bring the gripping points in line with the work, and

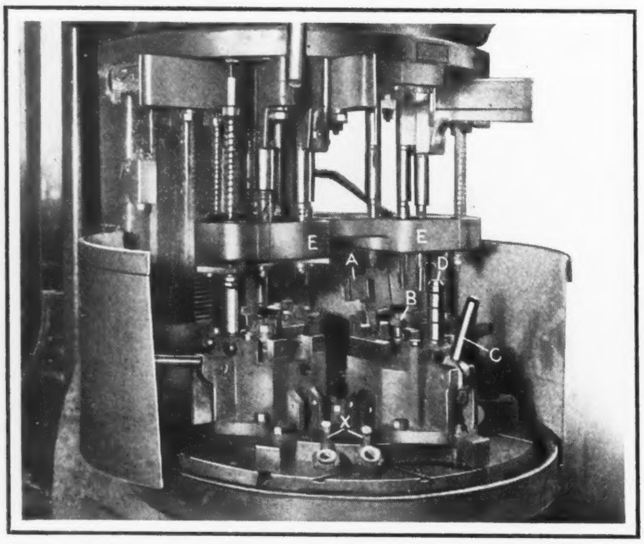


Fig. 4. Drilling, Semi-finish-reaming and Finish-reaming Operation on Valve-sleeve Connecting-rods

then the corresponding handle B is moved to draw the clamp points against the work. Handle C is depressed to withdraw a locking pin prior to indexing the fixture. The production in this operation averages 75 pairs of rods per hour.

Fig. 4 shows another operation on the valve-sleeve connecting-rods, in which the holes in both bosses are drilled, semi-finish-reamed, and finish-reamed. The fixture is of a four-station design, so that while tools are in operation on work held in three of the stations, work may be reloaded in the fourth station. Two rods are held at each station. As four tools in three different stations operate simultaneously on holes held to close limits, it is obvious that each station must register accurately with the tools.

Both holes of each rod are drilled in the first working position of the fixture, semi-finish-reamed in the second position, and finish-reamed in the third position. The rods are accurately located both sidewise and lengthwise, and are held down on hardened plates by means of hinged clamps such as shown at A. When this clamp is lowered, a slot allows it to clear the head of bolt B. This bolt is swiveled after the corresponding clamp has been lowered, to make the head bridge the slot, and then handle C is lowered to draw the bolt firmly on the clamp and lock it there.

Each of the three jig stations is equipped with a pilot D which enters bushings in the overhead bushing plate E attached to the drill head. All tools are accurately guided by means of bushings in this bushing plate, and, in addition, the reamers are guided in bushings located in the work-holding fixture stations. The production in this operation averages 28 pairs of rods per hour.

Babbitting Piston Connecting-rods

The crankshaft bearing of a piston connecting-rod is babbitted by means of the equipment illustrated in Fig. 6. This equipment consists of two centrifugal casting machines and two immersion-type, low-heat electric melting pots equipped with automatic control pyrometers. Each machine has a large disk, on the face of which are attached a suitable clamping mechanism and die-plates for forming the sides of the babbitt bearing.

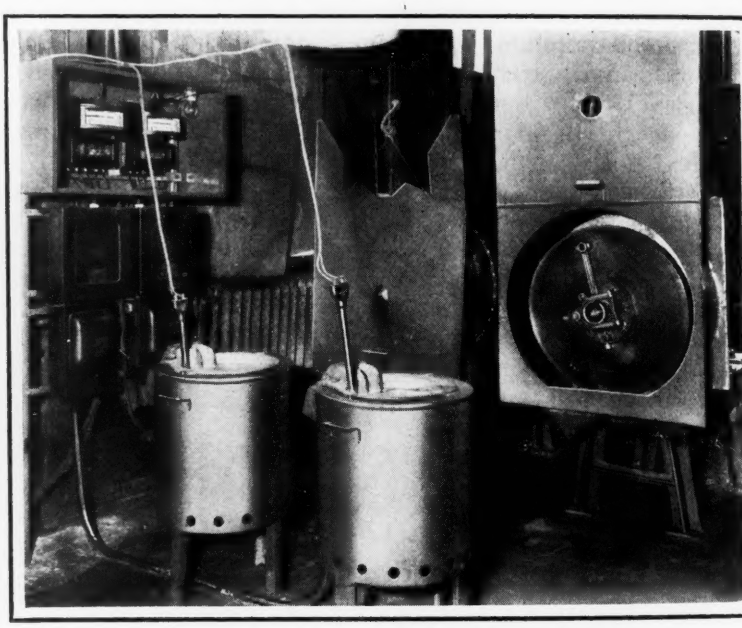


Fig. 6. Equipment Employed in Babbitting the Crankshaft Bearing of Connecting-rods

With a rod in place, as shown, and with the sliding cover lowered into the position illustrated on the left-hand machine, the disk is revolved at a speed of approximately 550 revolutions per minute. Then a ladleful of molten metal is poured into the crank bearing of the revolving connecting-rod through the opening in the cover. Centrifugal action forces the babbitt against the bearing wall with sufficient force to eliminate blow-holes. The cover prevents the babbitt from being thrown on the operator. The machine is allowed to run until the babbitt has solidified, which requires approximately three minutes.

In this operation, the inside diameter of the babbitt bearing is controlled by using a ladle that holds just enough metal to give a bearing of the desired

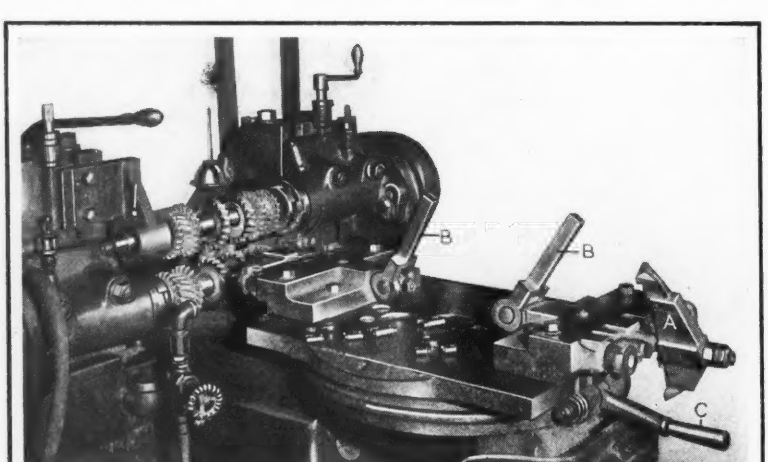


Fig. 5. Employing Sixteen Milling Cutters in an Automatic Milling Operation on Valve-sleeve Connecting-rods

thickness. The machines are belt-driven, and are each equipped with a friction clutch for starting and stopping the disk. Brakes actuated by the clutch levers stop the machines quickly when the power is shut off. With this equipment, 30 connecting-rods can be babbitted per hour.

The bearings and eccentrics of the eccentric shafts that actuate the valve-sleeve connecting-rods are finish-ground in machines of the type shown in the heading illustration.

* * *

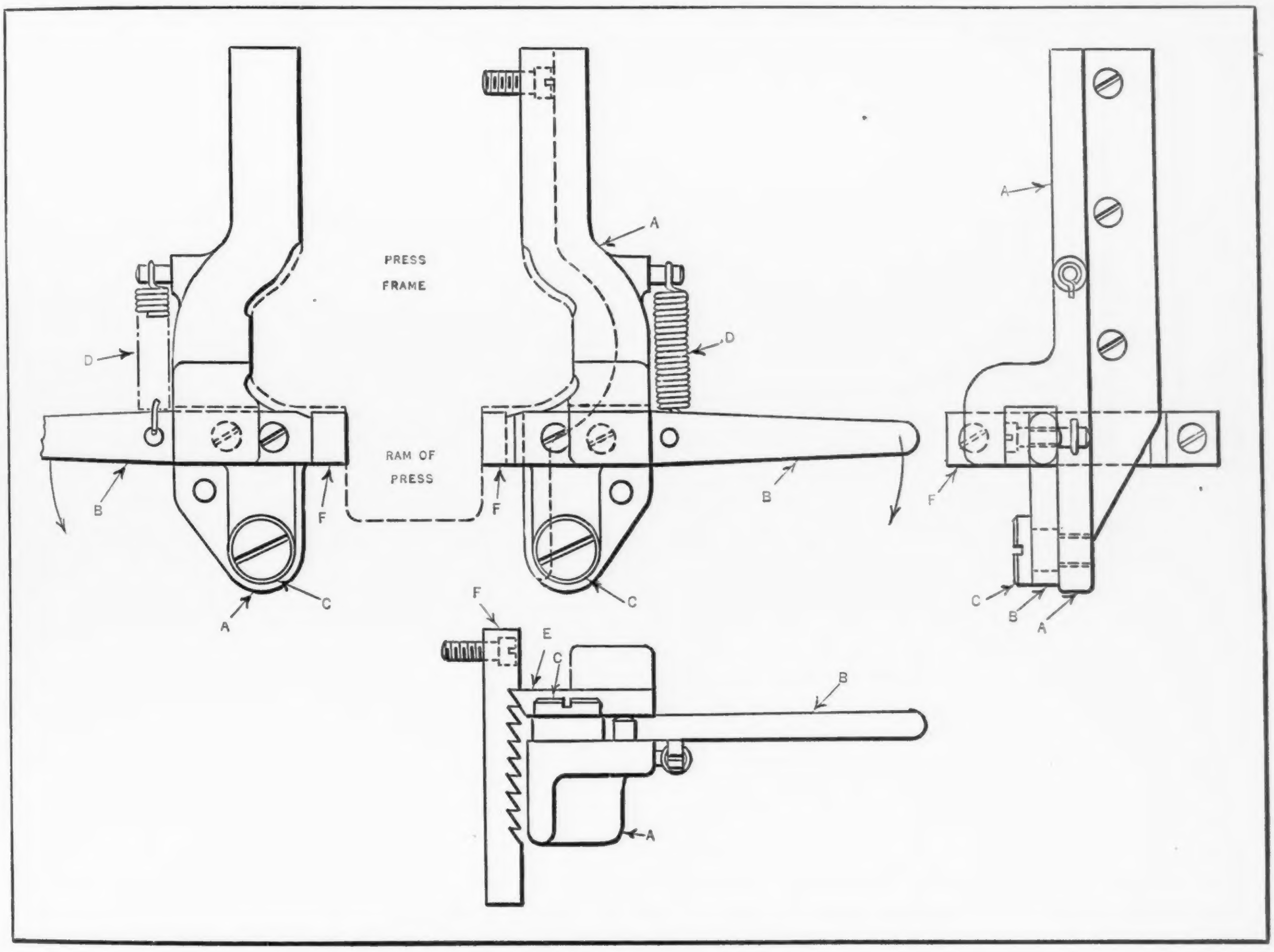
MAKING THE PRESS SHOP SAFE

By B. J. STERN

The article entitled "A New Plan for Making the Press Shop Safe," on page 121 of October MACHINERY, interested the writer greatly. It called to mind a simple safety device recently observed in a shop equipped with a large number of foot presses operated by girls. In this shop, considerable trouble was caused by injuries to the operators when, as frequently happened, they caught their fingers between the punch and die. To eliminate this trouble, a safety tripping device, such as shown in the illustration, was devised. This safety device makes it impossible for the girls to get their fingers caught, as both hands must be employed in its operation.

The tripping fixture has two brackets *A* fastened to the sides of the foot press frame, which are fitted to the shape of the frame, as indicated by the dotted lines. Mounted on the ends of the brackets, near the ram of the press, are two handles *B*, which swing on the shoulder screws *C* against the action of the stiff springs *D*. At the ends of these handles are screwed the hardened steel pieces *E* made to fit the buttress teeth of the racks *F*.

The racks *F* are fastened to the sides of the ram. In order to operate the press, it is necessary to use both hands, placing one hand on each handle. Pulling the handles away from the springs *D*, so that the blocks *E* leave the racks *F*, allows the ram to descend. On the up stroke, the operator releases the handles, allowing them to swing back until the blocks *E* catch in the teeth of the racks and lock the ram against any movement. Obviously, then, it is impossible for the press to operate unless the operator uses both hands to release the ram catches, thus removing the hands from the danger zone and reducing the possibility of accidents to a minimum.



Safety Tripping Device for Foot Press

* * *

WORTHLESS PATENTS

"Why Some Patents Prove Worthless" is the heading of another article by Leo T. Parker that will be published in April MACHINERY. In this article, the author points out some of the many pitfalls along the road that has to be traveled by the inventor and by the manufacturer who engages in promoting and pushing new inventions. One of the things that makes Mr. Parker's articles of great value is that while he deals with every question from the strict point of view of the patent law, he selects such examples as are easily understood by the layman.

What is the Most Ingenious Mechanism You Have Seen?

MACHINERY offers seven prizes for the seven best articles on ingenious mechanisms, each article to be confined to one mechanism or mechanical movement.

One prize—$100
Two prizes—each, $50
Four prizes—each, $25

In addition to the prizes awarded, regular space rates will be paid for the prize-winning articles, as well as for any accepted articles that may not receive a prize.

Each contestant may send as many articles as he wishes. All will be entered in the competition, and all may be accepted for publication, but no contestant will receive more than one prize.

Articles entered in this competition should be addressed to the Editor of MACHINERY, 148 Lafayette St., New York City. They must be mailed on or before April 1.

Preparing Articles for the Competition

This competition applies to any kind of mechanism making use of a practical and ingenious mechanical motion or principle. The competition is open to all, whether subscribers to MACHINERY or not. The general procedure is very simple.

1. Send a drawing of the mechanism (or photograph, if preferred—or both) that clearly shows all important parts of the particular movement to be described.

2. Describe as clearly as possible both the *purpose* of the mechanism and its *action*—*how* it does *what* it does.

3. Mark the important parts on the drawing, such as levers, cams, etc., with letters, *A*, *B*, etc., and use corresponding letters to identify those parts in the description; thus: "Lever *A* is operated by cam *B*, etc." This will help to make the description readily understood.

4. Confine each article to a single mechanism or movement, and do not describe an entire machine or refer to parts that do not affect the movement being described.

Suggestions about Illustrations and Manuscripts

Clear blueprints or pencil drawings with distinct lines are satisfactory. Send only drawings that are "to scale," with the various parts shown in correct relationship and proportion. Rough free-hand sketches cannot be used. The drawing must show the assembled mechanism, although a diagram or drawing that is partly diagrammatic may often be substituted to advantage, especially if it more clearly illustrates the arrangement of a complicated mechanism.

It is more essential that important facts be clearly stated than that the manuscript be neatly written, but carefully prepared manuscripts usually indicate careful thought.

Avoid describing a mechanism that is familiar to most designers; descriptions of movements that are generally known cannot be accepted, even though they may be very ingenious. It is immaterial how long ago a mechanism or movement was originally designed, provided it has not been described in any publication or text-book.

Notes and Comment on Engineering Topics

The first engineering exhibit ever held in China was recently arranged under the auspices of the Nanyang University of Shanghai in connection with the celebration of the thirtieth anniversary of the university. At this exhibit, machinery built all over the world was shown. More than fifty firms were listed as exhibitors, and more than twenty others who had applied for space could not be accommodated because of the limited exhibition area available.

The ancients had engineers whose abilities are by no means to be under-rated. The *Stone Trades Journal*, in referring to some of the ancient engineering structures, asserts that the ancients, with the meager facilities at their disposal, achieved even greater results, proportionately, than their modern followers. As one of these remarkable undertakings in the ancient world is mentioned the wall of the Acropolis at Baalbek in Syria, where huge stones weighing up to 1500 tons are so perfectly squared and so accurately placed in position that an ordinary knife blade cannot be inserted in the joints.

According to a report prepared by Charles L. Lawrance, president of the Wright Aeronautical Corporation, Paterson, N. J., airplanes provided with air-cooled engines, in commercial operation in the United States and Canada, flew approximately 1,775,000 miles in 1926, or the equivalent of seventy-one times around the earth at the equator. On all these flights there were only three forced landings due to the failure of a part of the motor. No injury or fatality was caused by these forced landings.

During the past year, the Westinghouse Electric & Mfg. Co., built four large electric locomotives for the Great Northern Railroad, each of these weighing 180 tons and having a length of 45 feet 6 inches. These locomotive units are operated in pairs, so that actually the complete engine weighs 360 tons. While these are not the first motor-generator engines built, the Great Northern Railroad is the first trunk line to use this type of locomotive exclusively for passenger and freight operation. The first motor-generator engines were built by Ford in 1924 with Westinghouse equipment.

COMBINATION RADIUS AND STRAIGHT TURNING AND BORING TURRET LATHE TOOLS

By ALBERT A. DOWD

It is a little out of the ordinary to turn a straight surface and generate a radius on the outside of a piece of work at the same time; and when these two operations are combined with boring, the equipment required, as shown in Fig. 1, is unusual, to say the least. This equipment was designed to be used on a Warner & Swasey turret lathe. The work *A* is a cast-iron casing, the central portion of which is turned to a radius of 8 1/16 inches at *B*. The outside is turned at *C* and threaded at *D*, and the inside is bored and reamed at *E* and *F*.

The work is held by one end in special jaws of a three-jaw chuck, and the boring is done by bar *G*, which is piloted in a bushing in the chuck. The holder for the bar is so made that it extends forward from the turret at *H* and carries a turning tool *K*. For clearness, it is indicated as lying in a horizontal plane, but in reality it is vertical. There is nothing unusual about these tools, except that they are made very sturdy to prevent vibration.

The radius tools are interesting, however, and their operation is unusual. The square turret on the cross-slide carriage is of the indexing type, and has four tool-holding faces, in one of which the block *L* is held by the regular tool-holding screws, as shown. The upper and lower part of the block have a good bearing against the side of the turret, in order to give greater rigidity. The radius tool-slide *M* is dovetailed to fit block *L*, and is gibbed to take up wear. Provision is made for holding a round-nosed tool *N* in the usual manner. A plate across the end of the tool-slide at *O* acts as a thrust block for a moderately stiff coil spring, which is intended to prevent backlash.

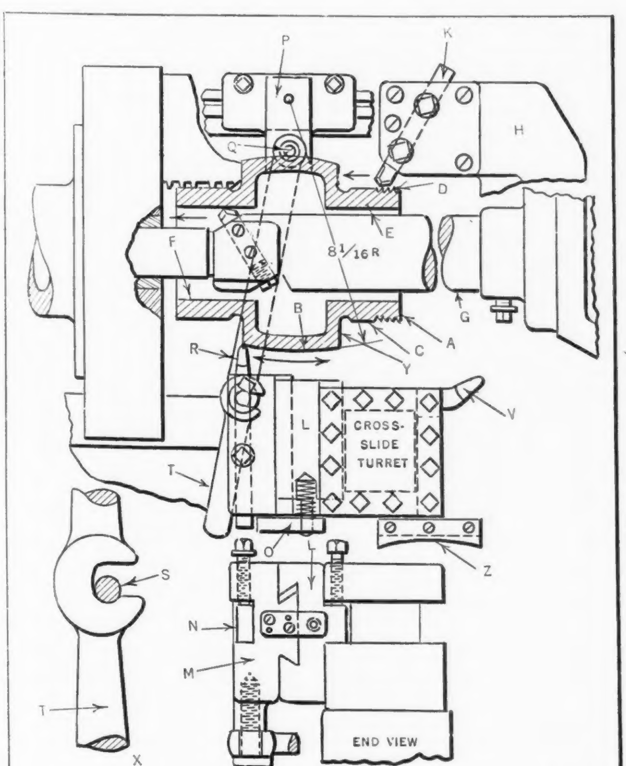


Fig. 1. Combination Radius and Straight Turning, Boring, and Facing Tools

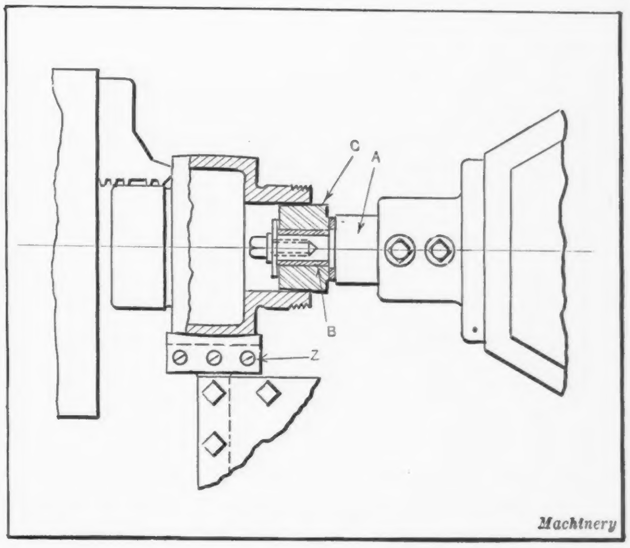


Fig. 2. Center Rest for Forming Radius

At the rear of the machine, on the ways, a cast-iron block *P* is fastened by means of a gib strap underneath the rail, so that it can be moved along and adjusted to the correct position. The radius rod *R* is pivoted at *Q*, and the forward end is slotted so that it can be readily engaged or disengaged with a pin *S* in the under side of the slide. The enlarged detail of the bar at *X* shows the method of seating pin *S* so that it cannot be displaced when the slide is in operation. The end of the bar is extended at *T* to form a handle. In the other faces of the cross-slide turret are the two tools *V* and *Z*, used, respectively, for facing surface *Y* and finish-scraping radius *B*.

In operating the equipment, the boring and turning tools are first started, and then the radius bar is engaged with the pin, and the longitudinal cross-slide feed started in the direction of the headstock. The radius slide, being controlled by the radius bar, causes the tool to generate the radius. The combined length of the two boring cuts at *E* and *F* is a trifle less than the forward and reverse cuts on the radius, so that the forward feeding movement is about completed on the radius just as the operator starts the boring-bar on bore *F*. The cross-slide carriage feed is then reversed, and the radius tool travels back again to the original position, reaching there shortly after the bar and turning tool have been withdrawn from the work. The operator usually has time to bring the die for cutting the thread into position as the radius cut is finished. The radius bar is then disconnected, and the threading and facing operations are completed one after the other. The end *A* is faced by a cutter held in one of the turret faces while the surface *Y* is being faced by tool *V*. The second boring cut is performed by a bar similar to the roughing bar, and the reaming by a piloted floating reamer. Only a single cut is taken on surface *C*.

After indexing the cross-slide turret to bring the scraping tool *Z* into position, a revolving center rest shown at *A* in Fig. 2 is brought up and entered in the end of the work to prevent chatter while the scraping cut is taken. The center rest consists of a steel shouldered bar on which is set a bronze bushing *B*. The hardened steel support *C* is ground on the outside to a taper of 0.002 inch per inch, so that it fits the hole snugly.

Current Editorial Comment

in the Machine-building and Kindred Industries

MACHINE TOOL DESIGNERS SHOULD VISIT PRODUCTION SHOPS

There are few manufacturing problems in the machine tool builder's own shop that resemble the production problems in many of the large plants to which he sells his product. The machine tool designer, therefore, cannot form a correct opinion of the requirements to be met by the machines that he designs, unless he visits high-production plants from time to time.

During recent years there has been active co-operation between automotive plants and machine tool manufacturers, and the doors of practically all automobile shops are open to machine tool designers. The most successful builders of equipment for the automotive industry have taken advantage of this condition by sending their designers to study the methods in automotive plants, and the entirely new outlook which they have acquired on the problems involved has been an important help toward their successful solution. They have been able to produce machines meeting the needs of plants using comparatively unskilled labor and operating on the piece-work plan, which means that machines must be built rugged and almost fool-proof, and capable of running continuously without receiving much attention.

Conditions are entirely different now from what they were in earlier days in the machine tool field when the machines sold were operated by mechanics almost as skilled as the men who built them. In those days, much could be left to the skill and judgment of the users; now, as little as possible should be left to them. To fully understand the conditions under which the machines are operated in high-production shops, the machine tool designer must visit those shops and study their production methods.

* * *

INSPECT YOUR MATERIALS

The quality of any machine or mechanical device depends mainly on three factors—the design, the workmanship and the materials. The first two of these factors usually receive much more attention than the third. The design is carefully scrutinized by a number of competent men, and suggestions for improvements are frequently incorporated. The workmanship is maintained at the required standard, not only by the supervision of foremen and the alertness of the superintendent or works manager, but also by the continuous checking up of inspectors.

But the materials used are not always carefully inspected. Care is generally taken in specifying the materials desired and the qualities that should be present in them; but usually the buyer depends on the seller to furnish the materials according to specifications, and frequently means are not available in the buyer's plant for testing them, so that often unsuitable materials may be used for a machine, the design and workmanship of which are of the highest quality.

To insure the maintenance of high quality in materials, a shop laboratory is necessary. This is not so expensive an adjunct as many think, for while it is not practicable for a very small shop to maintain a laboratory, those employing 200 men or more have found it not only practicable but profitable. In one plant the testing of all materials before their use in the product has reduced the number of scrapped parts to such an extent that the cost of maintaining the laboratory is small compared to the savings realized.

The equipment for such a laboratory need not be very expensive, but it pays to buy high-grade apparatus, the quality of which can be relied upon. The equipment for each shop depends, naturally, upon the kind of materials to be tested and the importance of different qualities in the materials. In some plants, tensile and elongation tests may be of the greatest importance; in others, the chemical analysis may be the deciding factor; in others, the micro-structure. The equipment, therefore, can be selected only after determining which qualities in the material should be most carefully tested.

* * *

EYE ACCIDENTS IN THE INDUSTRIES

Accidents to the eyes are among the most common casualties in machine shops, but they could be almost entirely eliminated if all workers who are in danger from flying chips would wear goggles to protect the eyes. Nearly all the larger firms in the machine-building field provide goggles for their workers, but often the men object to wearing them, thereby assuming great and unnecessary risks.

The National Committee for the Prevention of Blindness states that with the single exception of fatalities, eye accidents surpass all other industrial casualties in seriousness, considered either from the humanitarian or the production standpoint. Educating the workers to beware of the danger of flying chips and to protect themselves from such accidents seems to be the only means of reducing these accidents.

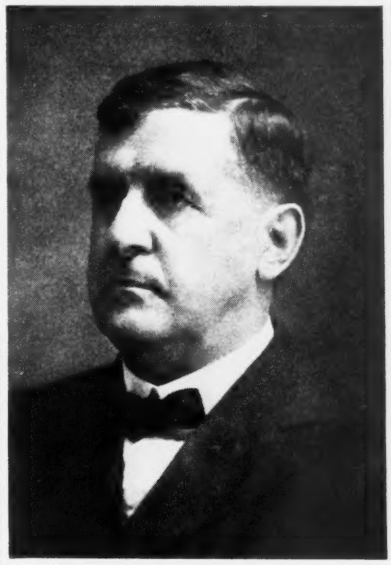
Apart from direct accidents to the eyes, the sight of workers is also impaired by unsuitable lighting of shops; and by unsuitable lighting is meant not only poor and insufficient light, but also excessively strong and glaring illumination. Of late, considerable attention has been given to proper artificial lighting of shops, so that at night and on dark days the shops may be lighted in a manner that avoids casting many shadows, and that will, as nearly as possible, produce the same effect on the eyes as daylight. Several of the new shops recently built for the manufacture of machine tools are excellent examples of what can be done in providing good artificial lighting in factories.

Some Problems in Machine Tool Manufacture

By J. G. BENEDICT, Treasurer and General Manager, Landis Machine Co., Waynesboro, Pa.

IT has been truly said that the machine tool manufacturer makes the tools that make the machines with which all commercial commodities are produced. The machine tool manufacturer, therefore, is responsible for what may be termed the original development in all lines of manufacturing today. Since the advent of the automobile and the flying machine, especially, the builder of machine tools has been called upon to produce remarkable results.

Prior to the time of these inventions, the Navy Yards were considered to be the machine tool builders' most exacting customers, but when the automotive industry began to demand closer limits and higher production at the same time, a new era was at hand. Following this, the great war forced upon all machine tool builders the urgent demand for the development of equipment for high production and absolute interchangeability. This demand is now made by practically every line of industry, and the machine tool manufacturer has had no small task in meeting the requirements of present-day demand for quality and quantity production.



J. G. Benedict

The greatest problem that the machine tool manufacturer has had to face, however, has not been the engineering problem of producing machines to meet the exacting demands of his customers, but the economic problem of how to obtain a sufficient price for his product; one reason this is so difficult is that the builder scarcely has time to jig up for a new machine and place it on a production basis before it has to be redesigned, and all drawings, jigs, fixtures, and tools for the previous design go on the scrap pile. The purchasing agent may think that the price of a machine tool is exorbitant when he considers only the size and weight of the machine; it is hard for him to understand that, with a limited production of any one particular type of machine tool, the overhead costs are excessive.

In addition, the machine tool manufacturer is expected to maintain a certain amount of excess capacity for building machine tools, due to the fact that the demand is never at an even level, but almost always either above or below what might be called "normal." Following the war, the machine tool manufacturers found themselves overbuilt and with great excess capacity. It was not until 1926 that most manufacturers found a fair proportion of this excess capacity occupied, either in producing their already developed lines, or in developing and bringing out new models which had become necessary to meet the increasing demand for production and simplified methods.

The excess capacity has also been partly utilized through the demand for machine tools in countries having very limited requirements before the war—a demand that, during the past year, has been quite satisfactory. There seems to be promise of an increase in foreign business, both from non-European countries, whose business was rather insignificant before the war, and from the European industry. The demand from Europe will be especially for high-grade and highly specialized machines.

With Europe gradually moving toward the solution of its economic troubles, there is every reason to believe that the machine tool industry in this country will be able to maintain a more even business level than during the years immediately following the war. This will be especially true if the domestic business remains at approximately its present level, which it doubtless will, if our people are able to stand prosperity and will not allow radical ideas and unproven theories to get ahead of their sound judgment.

* * *

SUMMER MEETING OF S. A. E.

Final decision to hold the semi-annual meeting of the Society of Automotive Engineers at French Lick Springs, Ind., this summer has been reached by the meetings committee of the society. The summer meeting is to be held just prior to the Memorial Day automobile races at Indianapolis, and will extend over four days. Other national meetings decided upon were the aeronautic meeting, to be held as usual in conjunction with the national air races next fall; the production meeting, to be held during the week of September 19 in a city not yet selected; the transportation and service meeting, in the early part of November at Cleveland; and the tractor meeting, to be held at the time of the meeting of the American Society of Agricultural Engineers.

* * *

He would be a rash man who would state that we are finally upon the golden stairs to the industrial millennium, but there is great hope that America is finding herself upon the road to a solution of the greatest of all her problems—that is, the method by which social satisfaction is to be attained with the preservation of private industry, initiative, and a full opportunity for the development of the individual.—*Herbert Hoover*

Milling Spirals in Flat Work

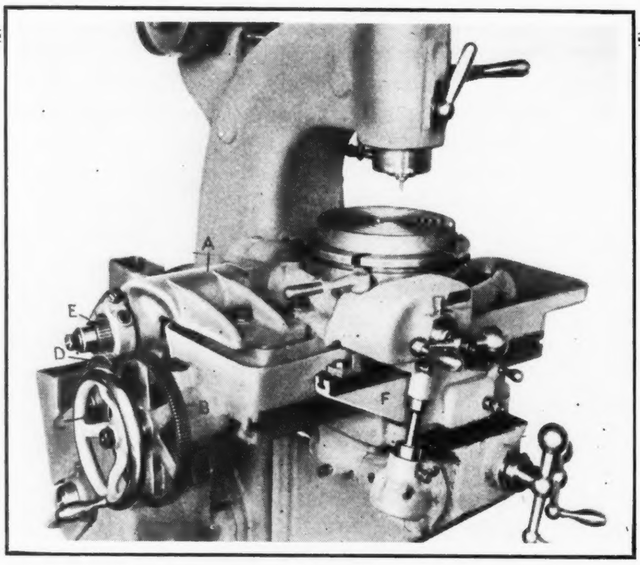


Fig. 1. Vertical Milling Machine Arranged for Cutting Spirals in Flat Work

SPIRAL grooves or slots can be quickly milled in disks and other flat pieces by means of the equipment illustrated in Fig. 1. The spirals may range in lead from 5/16 to 200 inches. Both right- and left-hand spirals can be produced, singly or in any number up to twelve. Typical examples of work are shown in Figs. 2 and 3. The example shown at *A*, Fig. 2, has three spirals; that at *B*, a single spiral; and those at *C* and *D*, four spirals. Both examples in Fig. 3 have two spirals, those of example *E* being joined in the center of the part. The disks illustrated in Fig. 2 are 3 1/4 inches in diameter and their spiral grooves are 1/4 inch wide, while the disks shown in Fig. 3 are 8 inches in diameter, with grooves 1/4 inch wide.

This spiral milling equipment was built by the Taylor & Fenn Co., Hartford, Conn., and consists primarily of the standard vertical milling machine and the standard power-feed circular milling attachment manufactured by that concern. A special mechanism provides longitudinal motion of the rectangular table at the proper ratio relative to the rotary movement of the circular table, or vice versa, to give the desired lead to the spiral being milled.

Construction of the Special Mechanism

The special mechanism is supported by bracket *A*, Fig. 1. Power may be delivered to the mechanism either by the feed-screw of the rectangular table or the feed-shaft of the circular table. The first mentioned source of power is used in milling spirals having long leads, and the second source in milling short-lead spirals. When the drive is from the feed-screw of the rectangular table, power is delivered through gear *B*, change-gear *C*, intermediate gear *D*, and change-gear *E*, to a shaft held by bracket *A*. The intermediate gear *D* and change-gear *C* are mounted on a rocker arm which may be adjusted to suit the diameter of the change-gears that are being used.

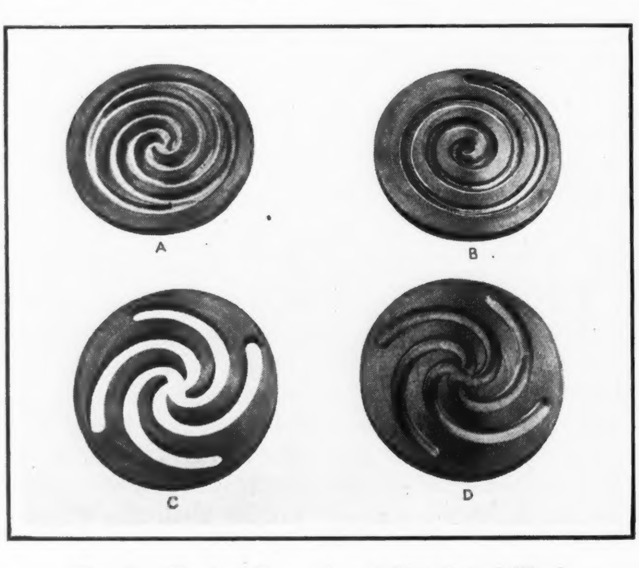


Fig. 2. Typical Examples of Flat Spiral Work

Keyed to the shaft on which change-gear *E* is mounted, there is a sleeve which is provided with a spring plunger that may be entered into any one of twelve index-holes spaced around the disk of a second sleeve mounted loosely on the same shaft. Integral with the loose sleeve there is a spiral pinion which meshes with a spiral gear fastened to the rear end of the circular table feed-shaft. This shaft drives the circular table through worm-gearing. To cut any number of spirals up to twelve in a part, it is merely necessary to enter the spring plunger of the keyed sleeve into the proper index-hole of the loose sleeve before taking each successive cut.

When power is transmitted through the feed-screw of the rectangular table, the regular dogs may be employed to insure that the spirals will be cut to accurate length. Bracket *F* is mounted on the cross-slide when the drive is to be transmitted through the feed-shaft of the circular table. A sliding dog on this bracket disengages the clutch of the circular table to insure that the spirals will be cut to accurate length. When this drive is being used, the regular drive to the feed-screw of the rectangular table is locked in neutral.

How the Change-gears are Selected

In milling the spirals, a two-lipped slotting end-mill is employed. As the throat of the machine is 8 inches, work up to 15 3/4 inches in diameter can be accommodated. Fig. 1 shows the equipment set up for milling right-hand spirals. To produce left-hand spirals, a second intermediate gear is provided in the train from gear *B* to gear *E*.

The ratio of the drive from the feed-screw of the rectangular table to the feed-shaft of the circular table, or vice versa, is such that if the change-gear *E* has twenty-four teeth, the change-gear *C* should have the same number of teeth as the number of sixty-fourths of an inch in the

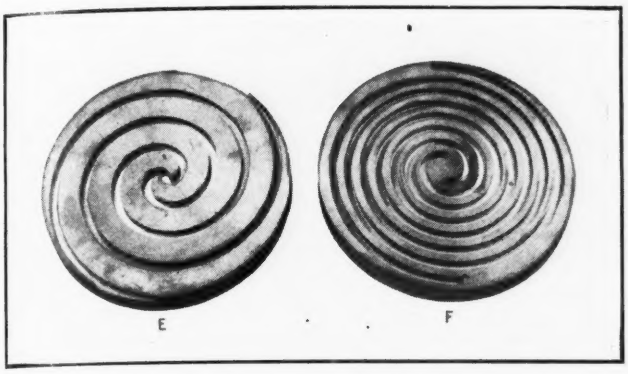


Fig. 3. Two More Examples of Spiral Work

lead of the spiral to be cut. For example, if the spiral lead is 1 13/32 inches (which equals 90/64 inches), gear C should have ninety teeth. If a change-gear C of 24 teeth were used, gear E should have the same number of teeth as the number of sixty-fourths of an inch in the lead of the spiral to be cut.

Should it be necessary to cut spirals having a lead finer than 5/16 inch, worm-gearing could be substituted for the spiral gears of the special mechanism. The drive would have to be transmitted from the circular table feed mechanism to the feed-screw of the rectangular table.

* * *

IMPORTANT ELEMENTS IN WELDING

In a paper presented before the International Acetylene Association's convention recently held in Chicago, S. W. Miller, consulting engineer of the Union Carbide and Carbon Research Laboratories, outlined the different factors that must be carefully observed in fusion welding. He emphasized the fact that fusion welding is in no way different from any other operation, because any operation can be either a success or a failure. It is true that the manipulation of the welding blowpipe is different from that of a lathe or other machine, but the same principle underlies both operations. Stated briefly, the procedure must be correct if success is to be attained, and as the procedure involves a number of elements, each one of them must be correct if the process is to be successful.

The following elements may be considered essential to procedure, regardless of what is being made: (1) Design; (2) materials; (3) methods; (4) operators; (5) supervision; and (6) tests.

1. *Design*—This must be such as will enable the welder to weld easily and cheaply and to do good work. Designs suitable for other forms of joining than welding are frequently very unsuitable for welding, and it is necessary for the designer to forget the other types of joining, and to learn to use those suitable for welding.

2. *Materials*—These must be such as will result in sound welds; both the base metal and the welding rod must be selected with this in view. The welder must also be considered, because while he may be able to use materials that are hard to weld, and while it might be necessary in some cases to do this, for general work this should be avoided, and materials should be selected accordingly.

3. *Methods*—This refers particularly to the use of suitable jigs, fixtures, clamps, and other tools, and to the order and way in which the various parts of the whole operation, including the preparation and finishing, are performed. Any of these things that make it easier to get better work are an advantage, and each design should be studied with this in view.

4. *Operators*—As in all other cases, much depends on the operator, but if he is handicapped by improper design, materials, or methods, the best results cannot be expected, no matter how good he is. Mr. Miller disagreed with the idea that the operator is the most important link in the chain. He did not think that any one of the items mentioned is of superior importance to the others.

5. *Supervision*—As in any other work, competent and careful supervision is necessary, and the supervisors must be competent to perform their duties. The supervisor should know not only the actual welding operation, but all other parts of the work.

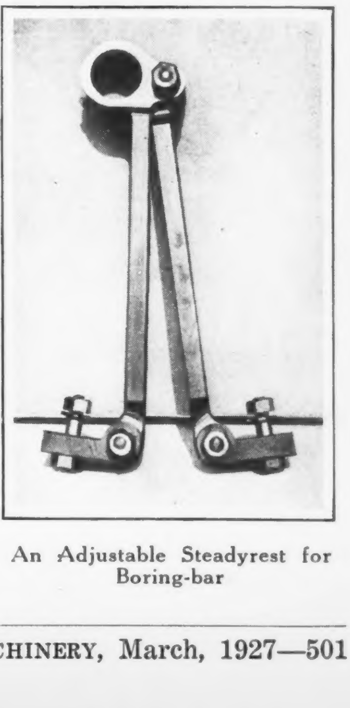
6. *Tests*—A weld cannot be inspected internally to determine its quality, but it has been amply demonstrated that tests can be devised that will prove the integrity of the welded structure, provided the other links in the chain receive the proper attention. There are many other structures to which the same statement applies. One of the best illustrations is concrete. There is no way of inspecting the interior of concrete, and procedure control in its construction is necessary and has been carried to a high degree of development. The testing of concrete structures is done in practically the same way that welds are tested—by applying a test load of more than the normal working load—and it has been found by experience in both concrete and welding work that when the procedure is proper, safe results are always obtained.

* * *

STEADYREST FOR BORING-BAR

By J. R. PHELPS, San Bernardino Shops, Atchison, Topeka & Santa Fe Railway, San Bernardino, Cal.

In railway repair shops, the boring of certain holes, such as those in truck center castings, requires a long bar of small diameter, and with such a bar, if a steadyrest is placed close to the work, where it is most needed, the boring can be done more rapidly and accurately. An adjustable steadyrest which can be raised or lowered merely by varying the distance between its supporting arms, is shown in the illustration. The center-to-center length of these arms is 18 1/4 inches, and the hinged joints are provided with 3/4-inch bolts. The hole for receiving the bar is 2 5/8 inches in diameter, and bushings are used for smaller bars.


An Adjustable Steadyrest for Boring-bar

Progressive Die with Adjustable Punches

By F. SERVER

THE difference between turning out a really satisfactory product and one that will just pass inspection is often a matter of adjustment, as provided for in the design of the die. One of the principal objects in designing the die shown in the accompanying illustrations was to provide means for adjusting independently, the forming punches which advance from the sides and form the small eyes on the edges of the work shown at *a*, Figs. 1 and 4.

This die is designed to take flat steel sheared to the required width and in standard lengths of about 14 feet. The first punch and die at *A*, Fig. 1, trims notches in both sides of the strip, the second die at *B* bends down the edges of the remaining prongs, while the curling punches at *C* complete the curling of the eyes, as indicated at *a*, Fig. 4. A short length of the work is notched and formed at each stroke of the press and the stock is fed forward the proper distance after each stroke by means of a roll feed of the usual type. Two punches at *D*, Fig. 1, pierce holes in the work at each stroke, and the pilot pins *E* enter these holes after the work has been advanced to bring the holes under the pins. The work is thus accurately registered after the feeding movement.

A cross-section through the trimming dies *A*, Fig. 1, is shown in the view at *X*, Fig. 4. The notching punches shear against the die-block *D*, and the round punches *E*, passing into holes in the die-block, pierce the holes in the work. While the punching operation is being performed, the block *F* is held in spring contact with the work so that it will be stripped from the punches as they ascend.

A better idea of the spring block construction may be had by referring to the end view, Fig. 2. At *Y*, Fig. 4, is shown a section of the first forming die which turns down the ends of the prongs *b* on the work. The punches *B* form the prongs over the formed block *G*, and in both the trimming and forming units the punches are backed up by a solid wall in the die so that there can be no tendency for them to spring away from the work while they are performing their allotted functions.

At the next station in the die the eyes on the work are formed completely by dies *C*, shown in Fig. 1 and in the cross-section view at *Z*, Fig. 4. In the end view, Fig. 2, the die is broken away to show the forming slide construction. The side punches *C* are mounted in blocks *H* which are attached by means of screws and dowels to the upper surface of the die-holder *I*. The punches *C* have springs *J* inserted in them which tend to hold the punches back from the position shown and clear of the work, so that the only time they are in the

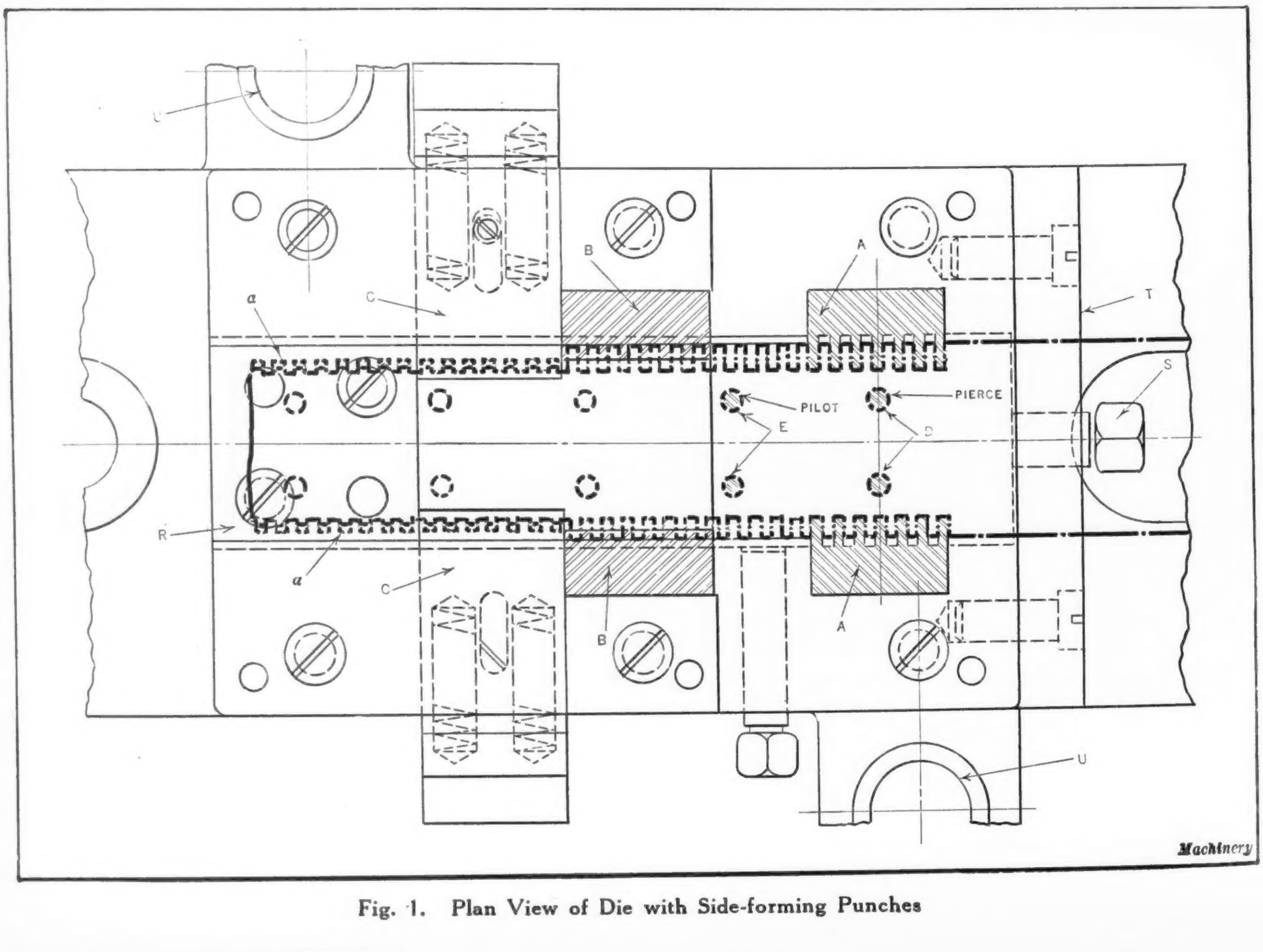


Fig. 1. Plan View of Die with Side-forming Punches

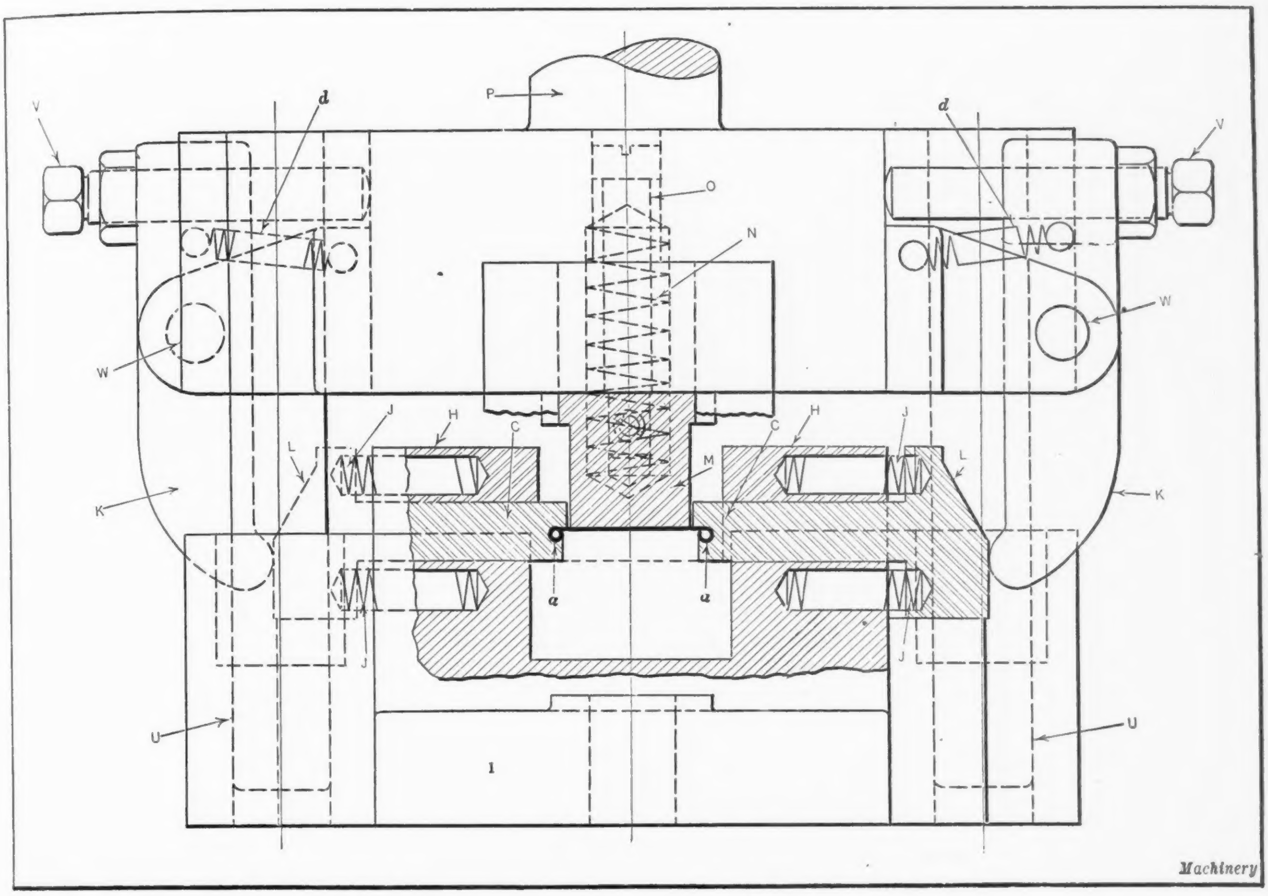


Fig. 2. End Elevation, Showing Section of Side-forming Punches

forward position shown, is at the bottom of the stroke when levers *K* have forced them in by coming in contact with the beveled surfaces *L* as the levers *K* descend with the punch-holder. This action of forcing the slides in causes the eyes on the work to be curled to shape. As the curl for the eyes is started at the previous station by punches *B*, Figs. 1 and 4, the curling operation is easily accomplished.

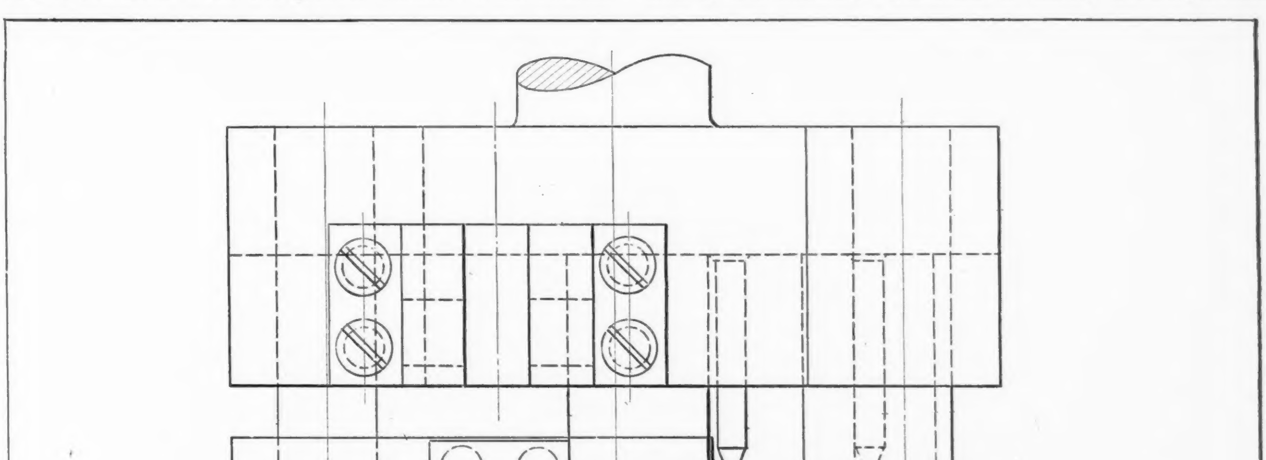


Fig. 3. Side Elevation of Die Shown in Fig. 1

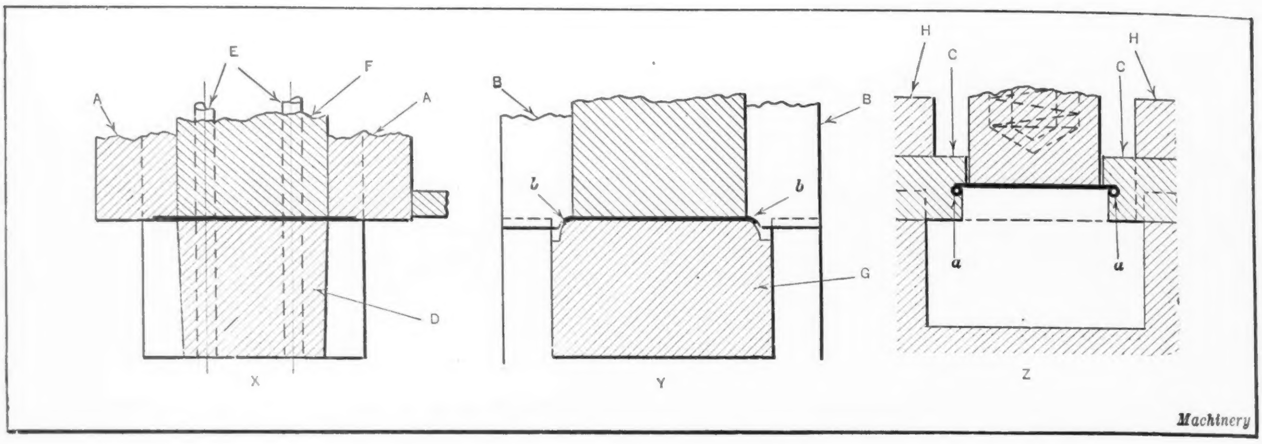


Fig. 4. Cross-section Through Punches and Dies

Spring block *M*, Fig. 2, which is forced down by a series of heavy springs *N*, holds down the work and strips it from the punches, the spring block being prevented from coming out of the die by screws *O*. The block *R*, Fig. 1, is fastened to the left-hand end of the die-block by screws and dowels. The various sections of the die are forced against this block by a screw *S* in plate *T* which is attached to the end of the die-bed. Pilot pins and bushings at *U* serve to keep the punch member properly aligned with the lower die member. The punch and the die-holder are attached to the press members in the usual manner.

Adjustment of the levers *K*, Fig. 2, so that the eyes on the work at *a* are properly closed, is effected by adjusting screws *V*, which cause the levers to swing on pivot studs *W*. This adjustment varies the movements of the slide punches *C*. The levers *K* are held in brackets attached by machine screws to the sides of the punch-holder. The springs *d* serve to hold the levers in contact with the screws *V* so that they will not be jarred out of place by the action of the punch.

* * *

NOVEL USE OF CIRCULAR SAWS

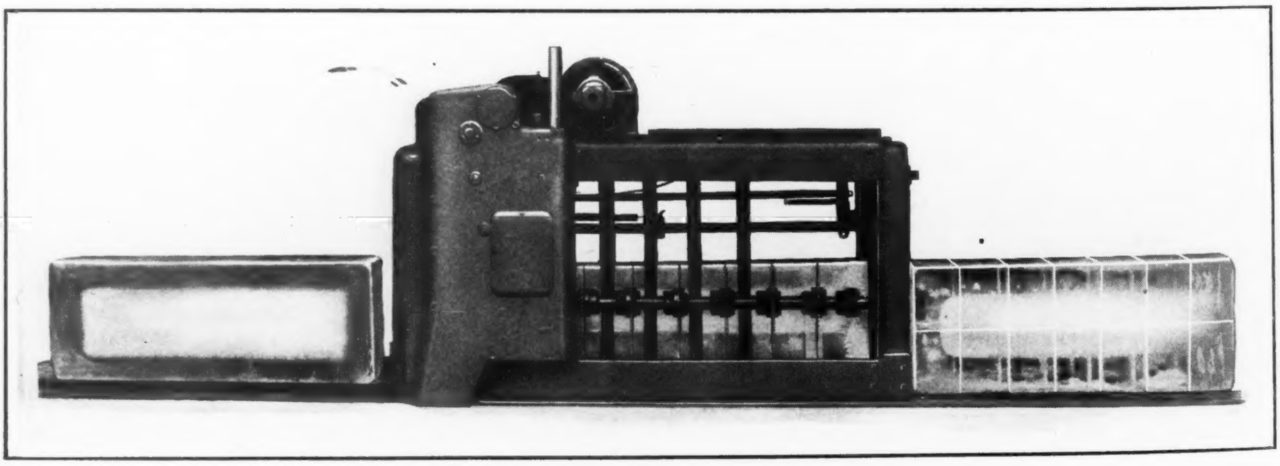
Circular saws are employed in the machine here illustrated for scoring 300- and 400-pound cakes of ice so that the cakes can be conveniently split into pieces weighing 25, 50, or 100 pounds. This machine is built by the Kent-Owens Machine Co., 958 Wall St., Toledo, Ohio, and marketed by the Uline Ice Scoring Machine Co. of the same city. The purpose of the machine is to guarantee correct weight to consumers, to eliminate the necessity of skilled ice delivery men, and to reduce the time required for delivering.

Saws are mounted on vertical shafts, located on both sides of the machine near the left-hand end, and revolve in a horizontal plane, scoring lines along the middle of the cake of ice as it is fed into the machine. When the cake has been fed against a stop near the right-hand end of the machine, it comes to rest. Then, saws mounted on horizontal shafts on the sides of the machine score vertical lines on the ice the desired distance apart to permit splitting off 25-, 50- or 100-pound pieces. The shaft on one side of the machine moves upward in this step and the other downward. These shafts next return to their starting position, and the entire cake of ice is delivered from the machine intact as a new cake enters from the opposite side.

Cuts 2 1/2 inches deep and 5/32 inch wide are made by the saws, and the small pieces of ice can easily be split from the main cake by applying an ice pick to the grooves. The large cakes of ice are scored at the rate of six per minute. Starting and stopping of the machine is controlled through a push-button switch. Parts of the mechanism exposed to moisture are made of rustproof metals.

* * *

The records of the Interstate Commerce Commission show that the railroads haul annually from 800,000 to 850,000 carloads of freight, consisting of automobiles, trucks, and parts.



Machine Equipped with Circular Saws for Scoring Ice

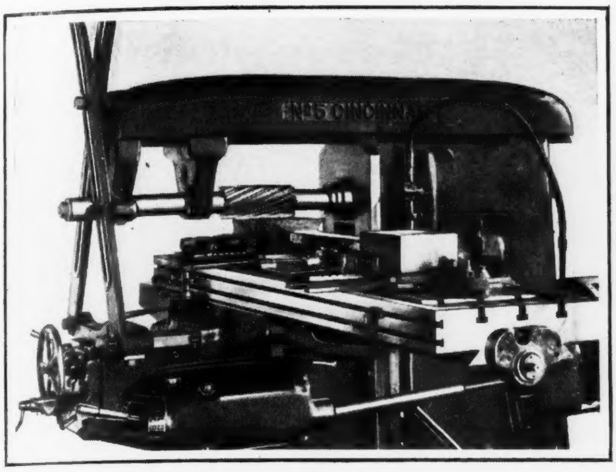


Fig. 1. Milling Sides of Connecting-rod Ends

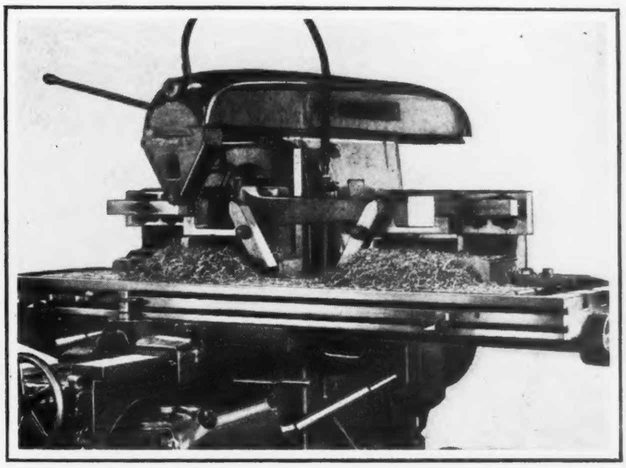


Fig. 2. Finish-milling Opening in Connecting-rod End

Production Milling in an Ice Machine Plant

By HOWARD ROWLAND

THE production milling of ice machine parts on a heavy-duty milling machine, equipped with simple fixtures, is described in this article. The equipment was recommended by the machine tool builder, whose engineers made a detailed analysis of the manufacturer's machining problems and prepared lay-outs and time studies covering the equipment described, previous to its purchase by the manufacturer.

The new equipment served to increase the production of various parts from 50 to 300 per cent, thus justifying the care taken in analyzing the machining problems, selecting the type of machine best suited for the work, and building the simple fixtures required. The machine on which the fixtures are used is a No. 5 Cincinnati milling machine with standard equipment throughout, except that a 66-inch table travel is provided for, in order to enable connecting-rods of various sizes to be milled.

Milling Sides and Edges of a Connecting-rod

In Fig. 1 the machine is shown set up for milling the sides of both ends of a connecting-rod for an ice machine. The stock is removed by a 4 1/2-inch diameter spiral mill. The rod is held in two all-steel vises, and is supported by parallel strips of the proper thickness. Simple strap clamps are used at the end of the table to prevent the rod from moving longitudinally.

A "steep spiral" mill was found to be of advantage in this particular operation, due to the width of the cut. It will be noted that the spiral cutting edges are nicked so that the chips will be broken up. A good quantity of lubricant is kept flowing over the cutter. In the illustration, the supply pipe has been removed to give a better view of the cutter. After completing the first milling operation, in which the sides of the rod are machined on the surfaces indicated by dot-and-dash lines at *A*, Fig. 3, the rods are turned over and the faces indicated by dot-and-dash lines at *B* milled.

Milling Openings in Connecting-rod Ends

Having milled the outside faces of the connecting-rod, the next operation is that of milling the opening at each end, employing the fixture and cutter shown in Fig. 2. The rod is machined from

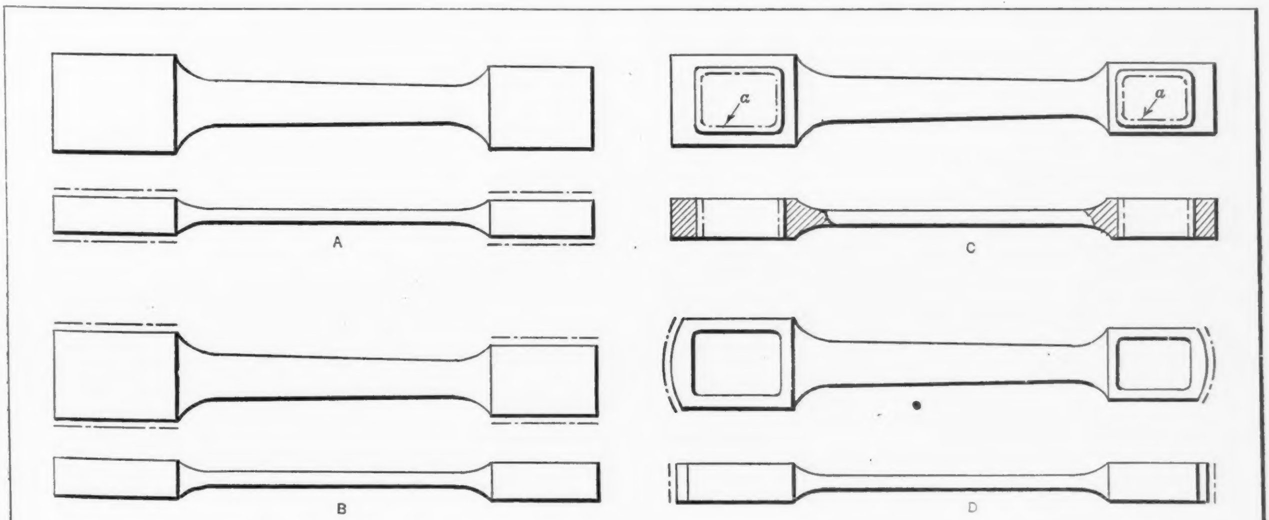


Fig. 3. Diagrams Showing Milled Surfaces by Dot-and-dash Lines

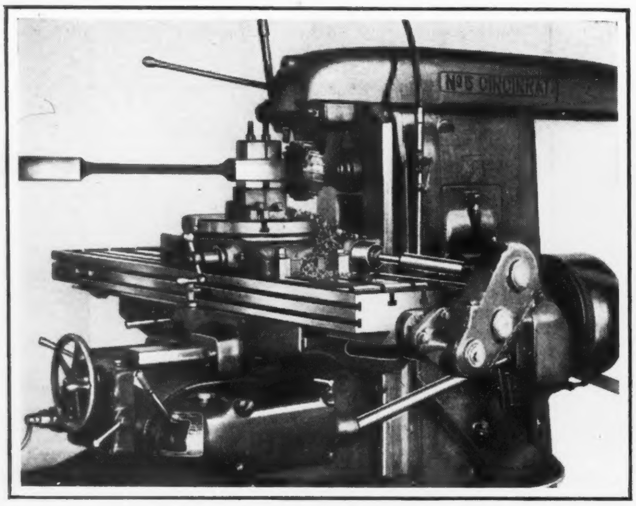


Fig. 4. Radius-milling End of Rod

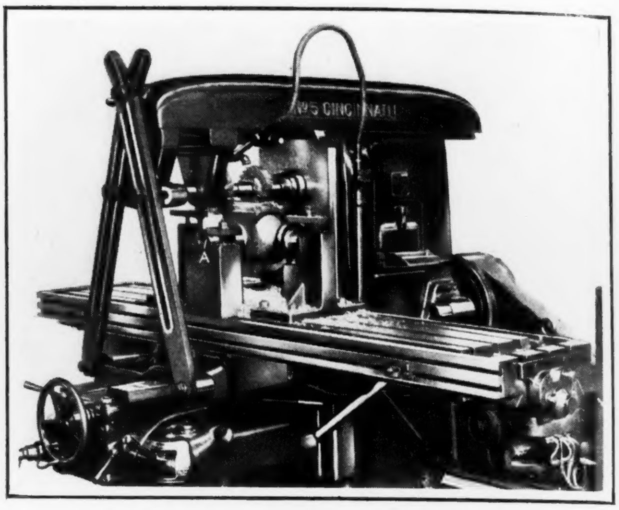


Fig. 5. Milling Cross-head

a steel forging, and the stock is removed from the solid. A helical mill 1 3/4 inches in diameter is used for roughing out the openings, and a 1 1/2-inch diameter helical mill for finishing. The feed used in this operation is 3/8 inch per minute. In order to obtain such a low rate of feed, it is necessary to take advantage of a special series of reducing gears, which can be readily applied to the machine.

The special universal fixture in which the rod is held while machining the openings is mounted on the machine table and holds one piece. The fixture is universal in that it will hold various types of rods. The work is located from the previously milled sides and edges, being clamped in place with the finished sides against the angle-plate of the fixture and supported by a fixed member at the larger end and an adjustable support at the small end. The fixture used for this operation is also employed in milling the edges of each end of the rod. In starting the opening-milling operation, the cutter is inserted through a hole drilled in the work, which is slightly larger than the diameter of the cutter. The required size of opening is obtained by taking a roughing and a finishing cut, the cutter following the path indicated by the dot-and-dash lines *a* in view *C*, Fig. 3.

For the finishing cut, the feed used is 1 1/4 inches per minute on the straight away milling, and 3/4 inch per minute for the finishing cut in the corners. For the opening in the large end, which in the rod shown, measures 6 3/4 by 4 3/4 inches by 3 inches thick, the time for rough-milling is approximately 25 minutes, and for the finishing cut, 27 1/2 minutes.

The time for rough-milling the opening in the small end, which is 5 1/2 by 3 3/4 inches, is about 15 minutes for the roughing cut and about 20 minutes for the finishing cut. This makes a total of 88 minutes for the rough- and finish-milling operations on the openings in the ends of the rod, and this time has been cut down somewhat since the operator has had practice in loading and unloading the work. The fact that the feeds are controlled at the front of the machine and can be quickly shifted from a higher to a lower feed enables the operator to keep the machine working at its maximum capacity.

It is interesting to know that the production on the opening-milling operation is now more than double the production obtained by the old methods of machining. In this case, the milling machine alone handles work that was formerly done on a drilling machine, planer, and shaper.

Radius-milling End of Rod

The third operation on the connecting-rod is that of milling the ends of the rod to the required radius, as indicated by the dot-and-dash lines at *D*, Fig. 3. Instead of developing an elaborate fixture for milling the ends of the rod to the required radius, a standard circular milling attachment is used, as shown in Fig. 4. It may not be out of place to mention here that standard attachments as a means of solving production problems are frequently overlooked, although many standard attachments can be bought at very reasonable prices that will handle work for which special fixtures would otherwise be required. In the present case, both ends of the forged steel connecting-rod are milled, about 1 3/8 inches of stock being removed. An 8 1/2-inch diameter inserted-blade mill, on a special extension adapter, is used for this work.

Special attention is called to the rigid support given the cutter by the rectangular over-arm. One connecting-rod is clamped in place on the special universal fixture mounted on the table of the circular milling attachment. The work is located from the finished sides and the opening at the end, and is held in place by a clamp over the top surface. As the rods are sawed off square at the ends there is considerable stock at the corners to be milled off, five cuts being necessary to finish the end to the required radius.

The actual rate of feed used is 4 11/16 inches per minute. The width

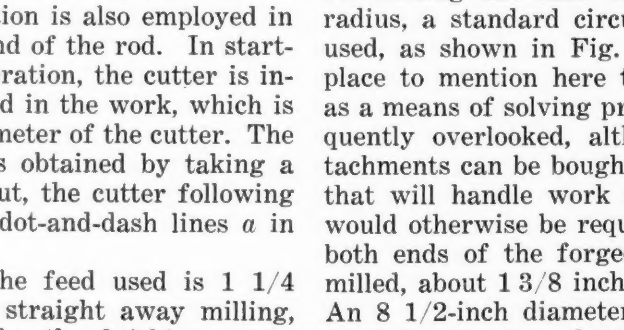


Fig. 6. Cross-head with Surfaces to be Milled Indicated by Dot-and-dash Lines

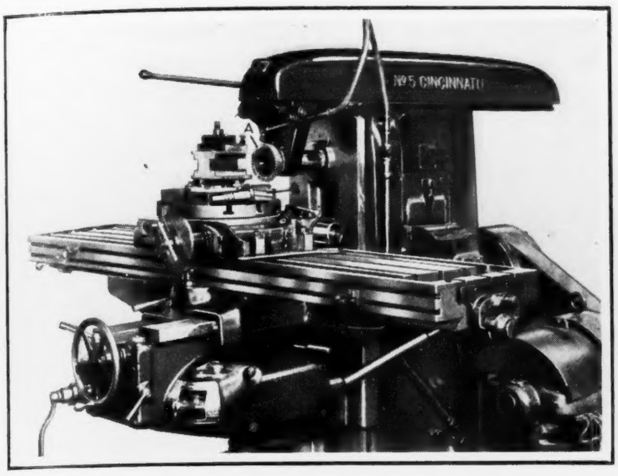


Fig. 7. Machine Set up for Milling Crank-head Box

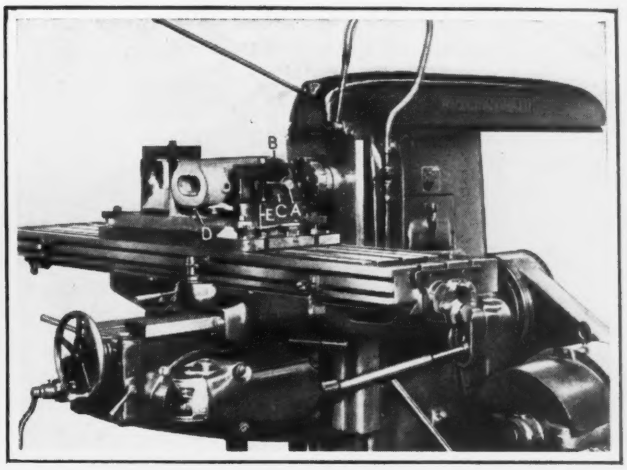


Fig. 8. Milling Compressor Frame

of the rod at each end is 3 inches. The rod shown in Fig. 4 has a center-to-center dimension of 30 3/8 inches. In the case of larger rods, the overhanging end is supported. It is interesting to know that the milling action, in using this equipment, is exceptionally smooth and that the finish produced is excellent. The three operations on the connecting-rod as described and illustrated represent a method of machining the type of rod used on ice machines, but the same or similar methods can also be used for connecting-rods for other machines.

Milling Cross-heads

The machining of the steel forged cross-head shown in Fig. 6 is also handled on the same milling machine, employing the set-up shown in Fig. 5. The sides, bevels, and top edges, as indicated by the dot-and-dash lines in Fig. 6, are required to be milled. The amount of stock removed varies from 1/16 to 3/8 inch. Two 7 1/2-inch diameter half side mills, two 3 1/2-inch spiral mills, and two 45-degree angular cutters make up the gang shown on the milling machine arbor in Fig. 5. This gang of cutters performs work at one pass of the milling machine table that would ordinarily require three operations.

The feed is 7 1/4 inches per minute, and the time per piece complete is about 9 minutes. A special mandrel *A*, Fig. 5, is mounted in the finished cross-bore of the cross-head, and this mandrel is clamped in the fixture V-blocks as shown. The V-blocks are of simple construction, yet they offer a rigid and accurate method of supporting the work. The turned end of the cross-head is also clamped on a fixed support, thus completing the location and clamping of the work.

After milling the sides, bevels, and edges on one side of the cross-head, the clamp used to hold the turned end of the work is removed, and the clamps over the mandrel are released. The cross-head is then swiveled about the mandrel as an axis, and reclamped with the turned end resting on the fixed support at the other end of the fixture. The work is now in position for milling the sides, bevels, and edges on the other side. The fixture can be arranged to hold cross-heads of various sizes by adjusting the supports under the turned end.

Machining Crank-head Boxes

Another part machined on the same milling machine is the crank-head box shown at *A*, Fig. 9. This box is made of bronze, and has four sides and slots to be milled. A 20-inch circular milling attachment shown in Fig. 7 is used, in order to eliminate the cost of special fixtures. The cutters consists of a 6-inch diameter special face mill *A* and a 3-inch diameter shell end-mill *B*, which has a quick adjustable collar, making it possible to insert the shell end-mill in the tapered hole without removing the face mills. These cutters remove about 1/8 inch of material.

One box is held in a special fixture mounted on the 20-inch circular milling attachment. The work is located from the finished bore and face, and is

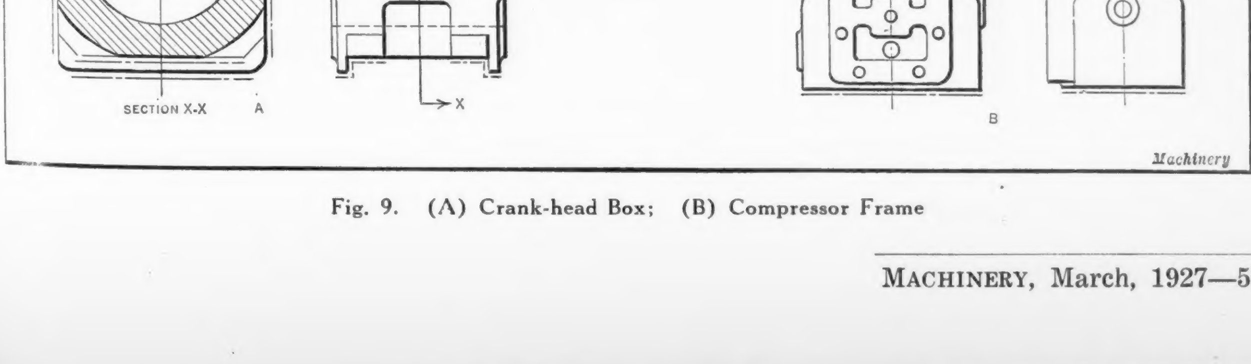


Fig. 9. (A) Crank-head Box; (B) Compressor Frame

clamped over the top surface. The special face mill is mounted on an extension arbor, which is supported close to the cutting point, as shown in Fig. 7. After milling the sides all around, the shell end-mill is mounted in the tapered hole in the extension arbor carrying the face mill, and the slots on the box milled. Roughing and finishing cuts are taken on the slots to secure accuracy with respect to the width of the slots. The index-plate mounted on the circular milling attachment facilitates accurate indexing of the attachment.

Milling Operations on Compressor Frame

In Fig. 8 is shown the milling machine set up for milling the top and bottom faces of a compressor frame. The material in this case is cast iron, and 1/4 inch of stock is removed. An 8 1/2-inch diameter face mill is employed at a feed of 9 1/4 inches per minute. With this feed, a piece is turned out complete in 7 1/2 minutes.

A simple 180-degree hand indexing fixture, mounted on the machine table, holds the work. The work is located from two end bosses by means of a mandrel *A* carrying two centering plates, one of which is shown at *B*. The mandrel passes through the cored hole in the work. The ends of the mandrel are clamped in V-blocks *C*, as shown. One end of the work is clamped over a fixed support *D*. Either the top or the bottom may be milled first, after which the fixture top plate is indexed 180 degrees preparatory to milling the remaining surface. The lever *E*, close to the fixture baseplate, operates a locating plunger block. This block and the clamps on each of the four corners of the fixture top plate are released before indexing and reset after the indexing operation is completed. Only one cut is taken on each of the surfaces milled, which are clearly indicated by the dot-and-dash lines at *B*, Fig. 9.

* * *

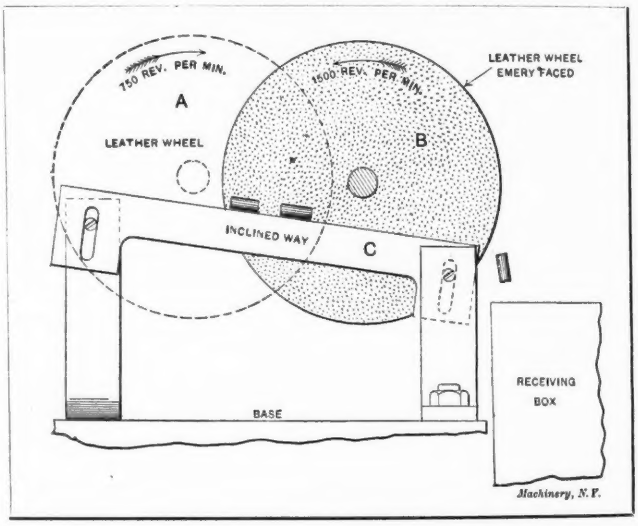
EARLY CENTERLESS ROLL-POLISHING MACHINE

By W. S. ROGERS, President, Bantam Ball Bearing Co., Bantam, Conn.

It may be of interest to the readers of MACHINERY to know that as early as 1897, a centerless roll-polishing machine was designed and built in my shop, the Ball Bearing Co. of Boston, Mass. A photograph of this machine appeared on page 68 of November, 1900, MACHINERY, and the accompanying diagram showing the mode of action was also shown in that number. The description of this machine as published at that time was as follows:

"One of the novel machines used in the production of roller bearings is the roll-polishing machine designed by Mr. Chadwick. Two leather disk wheels are mounted on parallel shafts, one slightly ahead of the other, so that their faces are held a short distance apart. The wheels overlap on each other nearly one-half the diameters and are belted to the countershaft so that they run in opposite directions. The plain leather wheel *A* runs at 750 revolutions per minute, and the emery-faced wheel *B*, at twice this rate and in the opposite direction. The wheel *A* is mounted on a shaft which can move endways in opposition to a coil spring. The spring gives the necessary pressure for the polishing process. A steel bar is held between the two wheels in an inclined position by two uprights secured to the base. The bar is slotted at the ends so that the degree of inclination can be changed to suit the size and length of the rolls. In operation, the small rolls are shoveled into a hopper (not shown) and are whirled through the machine into the receptacle at the rear, at a rate of about 5000 per hour. The larger and longer rolls require to be fed singly, and the polishing process is therefore slower, being about 500 per hour."

It will be noted that the writer of the article quoted from MACHINERY called this machine a "roll polishing machine." This was because he saw the rolls start black and come out bright and shiny, and no one thought of mentioning the fact that they were being ground. It was only after the article appeared in MACHINERY several months later that I discovered that the correspondent of the magazine had the wrong idea.



Reproduction of Illustration Showing Principle of Machine Described in 1900

The reason that the emery-faced wheel *B* was used instead of a regular grinding wheel was that at this time we had no money for experiments with grades of emery wheels, and no wheels of the type required were made by the wheel manufacturers.

Centerless grinding has been used by this company, both with one-wheel and two-wheel methods, for the last twenty-five years; and, in the old days, gun barrels were ground on "centerless grinders," in which the grinding wheel was a grindstone turned by hand, and the feed wheel was a wooden wheel covered with leather.

* * *

FIXTURES OPERATED BY COMPRESSED AIR

A great deal of interest has been evidenced of late in the subject of chucks and fixtures operated by compressed air. The first article of a series on this subject will appear in April MACHINERY. Those engaged in manufacturing processes in which pneumatically operated chucks and fixtures either are or could be used to advantage will find a great deal of interest in these articles. Beginning with April, one installment will be published each month for seven months to come.

What MACHINERY'S Readers Think

Contributions of General Interest are Solicited and Paid for

FOREMEN'S DAILY REPORTS

A notice was issued to every foreman in a certain plant, requesting him to forward to the general superintendent's office, daily, a report in which he would state exactly what he would tell the superintendent if he happened to meet him in the factory and was asked about how the work was coming along. At first, there was considerable resentment on the part of some of the foremen at being compelled to take up a pencil and write a report, but when they found that action was taken on such matters as were suggested in the daily report, they began to feel more kindly toward this innovation. An additional advantage of a report of this kind is that when a man has to put down something in writing about his job, it is frequently necessary for him to find out more about it than he knew before, as there is a demand for more exact knowledge when a thing is written than when it is just talked about.

Daily reports are of advantage in focussing the attention of the management on matters that may cause delay and trouble at frequent intervals. In one case, the factory management thought that the transportation system could be improved, but needed more definite knowledge regarding the troubles generally experienced, before taking any definite steps. The foremen were asked to mention, in their daily report, any difficulty that they had experienced the previous day with shop transportation. If they had a suggestion to offer for avoiding the trouble in the future, they were asked to make such a suggestion. In this way, the foremen were made to think more about the whole system of shop transportation, and when putting their complaints down in writing they were likely to be more accurate than when they related them verbally. With a number of these reports in hand, it was comparatively easy for the management to remedy the condition.

The daily report can also be used for calling attention to a great many other factors about the operation of a shop that the management ought to know.

J. S. G.

WHAT DO INTELLIGENCE TESTS TEST?

Each day another company is added to the long list of those already using intelligence tests to form the basis of selecting new employes and placing them in the position for which they are best suited. Many organizations are not only using this method for selecting new employes, but also for transferring those already employed to positions better suited to their natural aptitudes.

No intelligence test will apply absolutely and without failure to the individual case. However, considering a group, it has been found that the average results of intelligence tests correspond very closely with the average actual results obtained for the same group taken over a period of years. It would be folly to rely entirely upon an intelligence test in choosing a new employe or transferring an old one; but the test used as a basis and correlated with other known facts about the applicants, such as schooling, experience, and general appearance, gives safe results upon which to base conclusions.

The market today is flooded with all sorts of so-called intelligence tests, some of which are good, but the majority of which are valueless, because they are not reliable, easy to score or administer; nor are they valid, that is, they do not measure that for which they are intended. Each company, of course, has different requirements for its employes, and therefore, must arrange its tests accordingly. The actual test is something that each company must "dig out" for itself.

Naturally, from the name of the test, it is understood that we are attempting to test the intelligence of the applicant, but just what is intelligence is hard to define. A good test measures more than the knowledge that the applicant has obtained through study and experience. It tests also his neatness and thoroughness and the condition of his mind, or rather his development capacity. From my analysis of the results obtained through intelligence tests, compared with the results revealed by time, I find that the most important things tested are as follows: (1) Amount of general information; (2) neatness; (3) thoroughness; (4) speed of the mind; (5) reasoning power with regard to words; and (6) reasoning power with regard to numbers.

Some jobs do not require a man who is as fast as he is thorough and neat, while other jobs require men who must think and act quickly, and a man who is slow, even though his decisions are accurate, would not be fitted for the job. Therefore, we cannot consider simply the final score of the applicant and immediately say whether or not he should be employed. We must get down to the fundamental requirements of the job and compare these with the results of the test.

It is interesting to note that in one of the large industrial plants employing an intelligence test, it was found that the lowest labor turnover was in the group whose intelligence test grades were average or slightly above. Those who had a low grade became dissatisfied because they could not make enough money, and those on the other end of the scale were naturally ambitious and reached out for bigger opportunities. I believe this shows that the intelligence test is of considerable value.

Intelligence tests, which today are criticized so severely by many authorities, are being used more every day, and eventually will become the standard equipment of every large concern.

B. A. CARSTENSEN

THE MACHINE TOOL CENSUS FOR 1925

The statistics collected by the Department of Commerce in the biennial census of manufactures covering the year 1925, have just been given out for publication in so far as they apply to the metal-working industry. The total production of such machinery in 1925 was valued at $117,891,697; parts and attachments were made to a value of $32,602,289; and all other products, including contract work and repair parts, to a value of $25,097,502, making a total of $175,591,488. The accompanying table gives the totals for different classes of machines.

Of the 378 establishments reporting, 93 were located in Ohio, 37 in Connecticut, 36 in Massachusetts, 34 in Michigan, 33 in Illinois, 30 in Pennsylvania, 26 in New York, 20 in Wisconsin, 12 in Indiana, 12 in New Jersey, 8 in Rhode Island, 6 in Vermont, 5 each in California, Kentucky, Minnesota, and New Hampshire, 4 in Missouri, 3 in Maryland, and 1 each in Colorado, Delaware, Iowa, and Nebraska.

The average number of wage earners engaged in the building of metal-working machinery was 36,325, the maximum number being employed in December—42,966—and the minimum number in January—32,887. The total amount of wages paid during the year was $55,931,810. The cost of materials used, including fuel, electric power and mill supplies, was $54,524,362, so that the value added by the industry in the manufacturing processes was equal to $121,068,126.

In the census taken in 1921 and 1923, machine tools only were considered, but in the 1925 census the scope of the statistics has been broadened to include all metal-working machinery.

* * *

We have reached the point in this country where we should know enough concerning intelligent control and direction of economic conditions to prevent the occurrence of so-called "hard times." If people would stop talking about good and bad business and concentrate on normal business, many of the evils would vanish.—*Henry Ford*

Production of Metal-working Machinery in 1925 and 1923

Kind of Machines	1925		1923	
	Number	Value	Number	Value
Bending machines	807	$641,711	616	$616,443
Boring machines:				
Horizontal	581	1,683,924	477	1,231,584
Vertical	219	1,344,137	326	2,345,772
Broaching machines	435	540,093	235	347,317
Cutting-off machines:				
Rotary-cutter type	250	294,168	299	404,467
Hacksaw type	1499	197,463	652	207,873
Drilling machines (stationary):				
Multiple-spindle	1211	2,109,738	*	*
Radial	830	2,038,392	922	2,431,268
Sensitive	3577	1,776,238	2612	1,228,455
Vertical (upright)	2256	998,234	2506	1,048,781
Forging machines:				
Bolt, nut, and rivet	18	219,810	24	100,885
Bulldozers and other	65	541,610	96	711,992
Gear-cutting machines:				
Generator, hobbing type	647	2,025,735		
Formed and disk-cutter types, and other	624	2,232,615	1107	3,506,206
Grinding machines:				
Cylindrical				
Plain	*	3,136,075	*	2,580,767
Universal	330	508,500		
Surface	894	1,466,760	1034	2,122,134
Cutter, tool, and knife	1501	1,716,744	988	1,052,843
Internal	765	2,005,278	515	888,620
Other	1346	1,501,820	*	1,137,318
Hammers (stationary):				
Drop	201	407,608	122	164,220
Steam or air and other power (belt- or motor-driven)	654	421,850	534	276,322
Lathes:				
Engine	5165	7,675,897	7295	8,884,904
Bench	930	397,627	950	462,123
Turret (including hand screw machines)	1567	4,155,054	2544	5,320,087
Other	*	4,090,746	1197	4,323,371
Milling machines:				
Hand feed	450	207,855	274	93,794
Power feed				
Plain	723	1,624,617	1063	1,881,709
Universal	599	1,360,884	453	959,967
Vertical	333	860,080	328	770,541
Lincoln type	374	679,101	194	438,950
Planer type	121	1,022,037	56	672,969
Other	202	534,261	538	1,229,295
Pipe-cutting and threading machines	2624	1,298,459	1958	1,002,497
Planers	193	1,104,786	302	2,110,093
Presses:				
Hydraulic				
Bending and forming	1015	1,592,075	501	553,839
Forging	38	81,247	274	124,355
Power, for sheet-metal work	5002	5,108,103	5730	5,465,626
Punching machines (stationary)	1018	1,879,206	1390	1,119,302
Riveting machines (stationary)	1337	473,591	1947	658,218
Screw machines, automatic:				
Multiple-spindle	1140	3,971,721	954	2,833,781
Single-spindle	1161	1,947,545	1159	2,006,958
Shapers	1125	1,614,760	1569	2,052,805
Shears (power)	1887	1,347,940	1763	980,689
Slotters	62	404,968	81	446,363
Threading machines (except for pipe):				
Die type	153	171,127	162	277,515
Milling type	81	344,106	115	371,968
Tapping machines and rolling type	336	323,287	580	439,427
All other metal-working machinery	†	45,812,114	....	‡
Parts and attachments	....	32,602,289	....	25,460,514
All other products	....	21,205,421	....	
Amount received for contract work and repairs	....	3,892,081	....	8,571,124
Total value		175,591,488		‡

*Data incomplete.

†Rolling-mill, sheet-metal working, welding, wire-drawing, and wire-working machinery; power-driven motor tools, other than electrically driven portable tools made by establishments engaged chiefly in the manufacture of electrical machinery, apparatus, and supplies; and other metal-working machinery not specified above.

‡Because of changes in classification, no figures comparable with those for 1925 can be given for the total value of products or the value of "All other metal-working machinery." The value of rolling-mill, sheet-metal working, welding, wire-drawing, and wire-working machinery manufactured in 1925 is included in the amount shown for that year, but cannot be included for 1923, because establishments manufacturing these products were classified in the "Foundry and machine shop products" industry at the census for 1923.

Methods of Holding Tools and Cutters

Third of a Series of Articles

By FRED HORNER

AMONG the most effective means for holding or securing a tool in place is the clamp. A clamp can be made with a gripping surface of comparatively large area, specially shaped to fit the tool or cutter closely. The body of a properly designed clamp will absorb vibrations and, to a certain extent, assist in conveying the heat developed by the cutting action away from the tool point.

In some cases, the clamp can be so designed that there will be less overhang or projection of the cutting portion than with the direct screw type of fastening. Clamps of the simplest type or generally found on slotter and planer tool-boxes and the slide rests of the heavier types of lathes, although the practice of using single or double clamps on small lathes is favored by British manufacturers.

Clamps for heavy cuts usually have serrated steel strips sunk in the supporting face, to prevent the tool shanks from slipping. A clamp of this type is shown in Fig. 13. Some of the tool-holders on the largest planers have six instead of four clamping bolts, which are preferably a loose fit in the T-slots. If the bolts are made a loose fit in the T-slots, the clamps can be easily set at angles best adapted for holding the tools. Single clamps of triangular shape are much used on small British lathes, one corner of the triangular piece receiving a screw which makes contact with the top of the slide-rest and permits adjustment to suit the thickness of the tool.

Heavy-duty Tool Clamps

Since the advent of high-speed steel, the practice in clamping the tools in place has undergone a change, particularly in the case of lathes for turning and re-turning car wheels. This class of machines requires powerful tool-holders in which the tools can be changed quickly. The usual bolt arrangement has been discarded in many cases in favor of a lever clamping device having greater power. One of the improved designs has a massive clamp, which is first adjusted by a wing-nut on the clamping bolt and then tilted by means of a screw at the opposite end which is operated by a ratchet handle. Such an arrangement gives greater gripping power without requiring much exertion on the part of the operator.

The design used by J. Hetherington & Sons, Ltd., Manchester, England, shown in Fig. 14, is a good example of this method of clamping. The bearing face *A* of the clamp is relieved in order to provide two gripping surfaces on the tool.

Another style of clamp used by the same company for holding roughing and finishing tools that are grouped close together is shown at *B*, Fig. 15. Each clamp is so arranged that the tightening of the screw *E* exerts pressure on the front and rear of the tool simultaneously at points *F* and *G*.

A similar clamp, shown at *A*, which is designed to hold forming tools *H* having dovetailed shanks, is used for turning the whole width of the tire of a car wheel. This type of clamp is used by Noble & Lund, Ltd., Felling-on-Tyne, England. On releasing the clamp, the tool can be instantly slid out and another tool put in its place.

Air-operated Clamp

In order to facilitate the clamping and releasing of tools on heavy-duty wheel-turning lathes, the

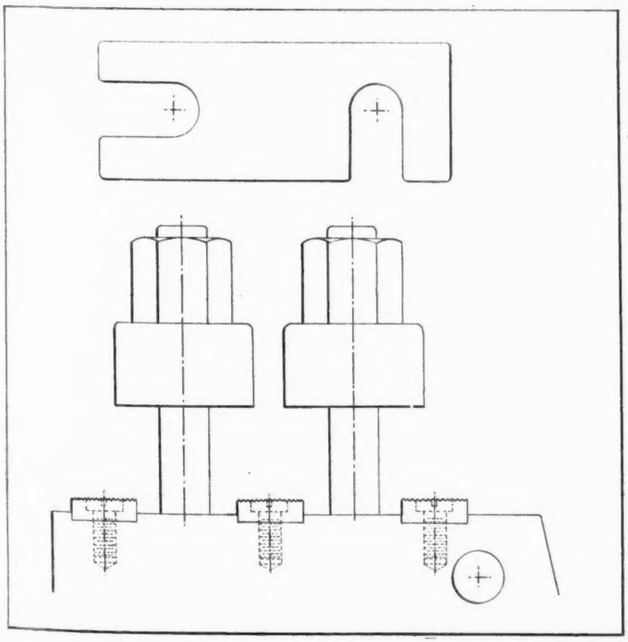


Fig. 13. Clamp with Serrated Steel Supporting Strips

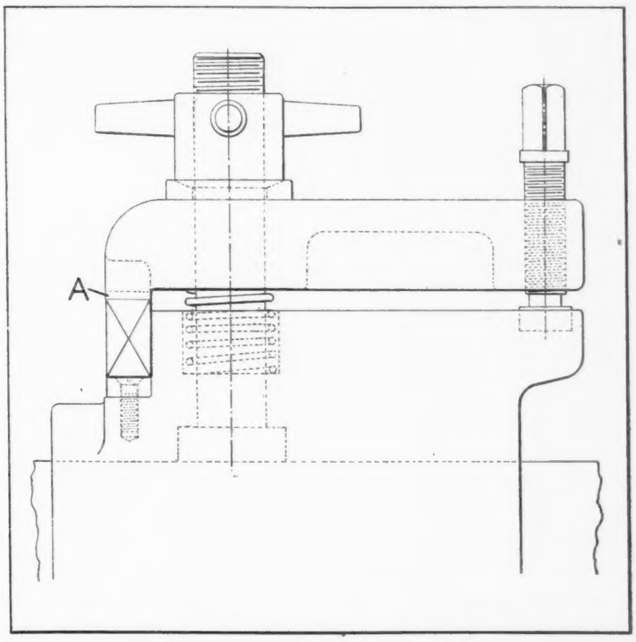


Fig. 14. Tool Clamp Employed on Wheel Lathe

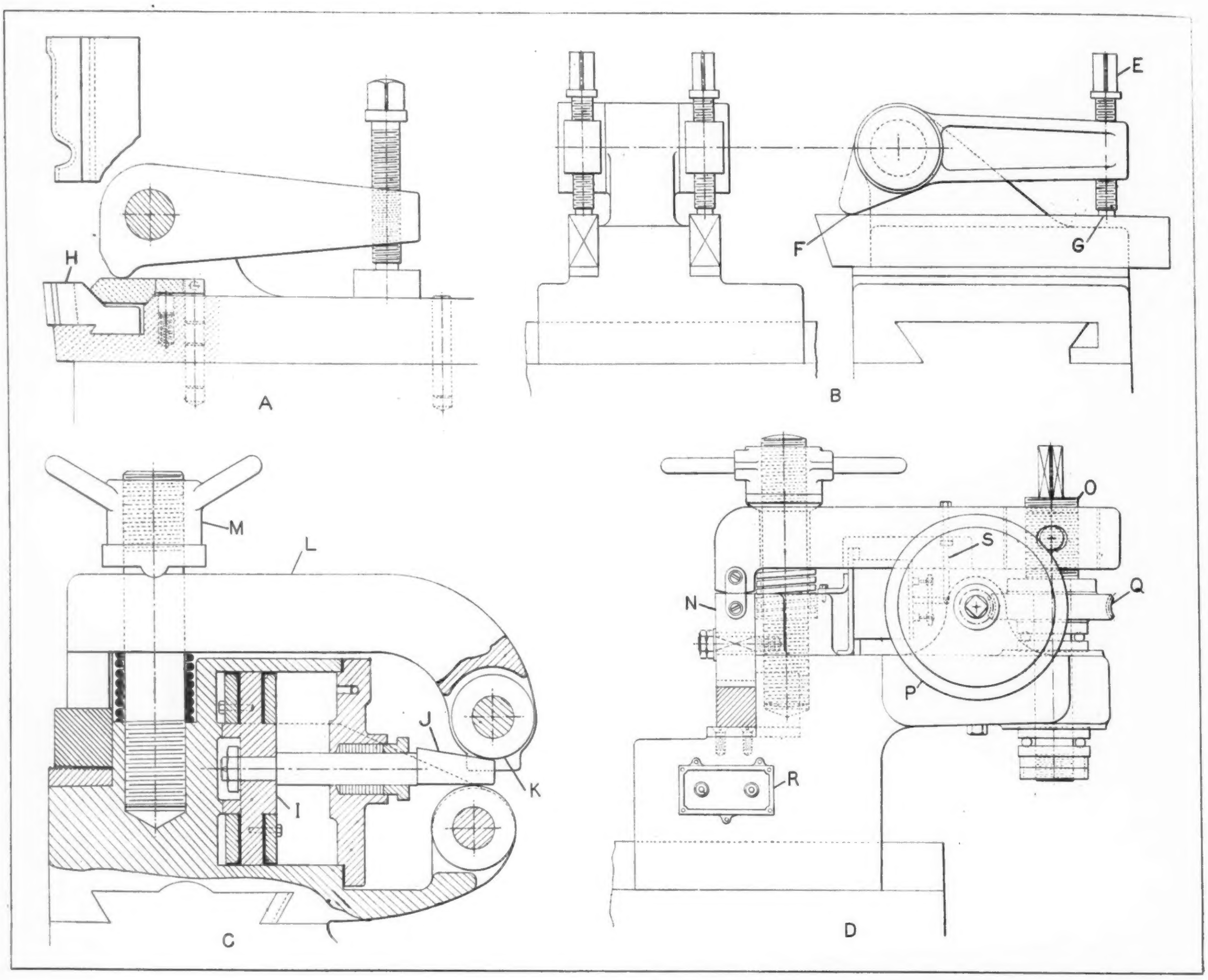


Fig. 15. (A) Clamp for Holding Form Tools; (B) Duplex Holder with Lever Clamps; (C) Air-operated Wheel Lathe Tool Clamp; (D) Electrically Operated Clamp for Wheel Lathe

Niles-Bement-Pond Co. equips machines of this type with power-operated clamping devices actuated by air cylinders. One of these clamps having air cylinders built into the top part of the slide is shown at *C*, Fig. 15. The outward thrust of the piston *I* forces the wedge *J* between a fixed lower roller and a roller *K* at the end of the clamp. The angle of the wedge and the position of the rollers are such that the wedge is self-locking. The clamp *L* is so adjusted by means of the wing-nut *M* that a powerful gripping force is exerted on the tool, which can be released only by admitting air to the cylinder on the opposite side of the piston.

Electrically Operated Clamp

An electric clamp fitted to the rests of the heavy locomotive wheel lathes made by Armstrong, Whitworth & Co., Ltd., Manchester, England, is shown at *D*, Fig. 15. In this design, the clamp has a rocking movement under the adjusting nut, and the nose has a convex surface designed to give the proper bearing on the heavy pad *N* which clamps the tool in place. If the screw *O* is turned by a handle fitted to the squared top, the clamp will be tilted and the tool gripped tightly in place.

The same clamping action is also obtained by switching on the one-horsepower motor *P*. A worm on the motor shaft rotates the worm-wheel *Q* secured to screw *O*. The worm is attached to the motor shaft by a slip clutch, which prevents overloading. This clutch, however, is provided with teeth which are positively engaged when the direction of rotation is reversed in order to release the tool. The motor switch buttons are located on the plate *R*, and an automatic contact breaker is fitted to the machine at *S*, which cuts off the current when the clamp has reached certain positions.

Method of Fastening Milling Cutter Blades

Although the clamp and screw is not generally considered a practical arrangement for securing the blades of a milling cutter, it is possible to employ this method for holding the cutters in some designs of face mills, where the clamp and screw do not interfere with the work. Each blade of the Ingersoll heavy face cutters, for instance, is held in place by a heavy clamp and screw located on the sloping rim.

The breaking up of the chips is effected by making the teeth of the larger cutters alternately square and rectangular in section, the sizes used in one case, for instance, being 3/4 inch square and 3/4 inch by 1 1/4 inches. The cutters are sunk in so that they are almost level with the surface of the holder. The practice of sinking in the cutters is also employed for many kinds of multiple tool outfits for lathes, the blocks being milled out to exactly fit the tools at the angular setting desired. With this construction, a comparatively light pressure of the clamp on the tools is required.

In many cases, one clamp can be used to hold two tools or blades in place, a convex surface being machined on each of the contact faces in order to equalize the clamping pressure on the tools. An example of this method of holding two tools is shown at *A*, Fig. 16.

Clamps may also serve a double purpose in some of the boring heads, as in the case of the holder shown at *A*, Fig. 17, and the Pratt & Whitney adjustable reamer shown at *B*. In the latter design, the blades are moved up inclined grooves by a nut at the rear end of the blades, and finally clamped in place by the shoes.

Method of Holding Cutting-off Tools

It is not feasible to grip more than two tools or blades with a single clamp unless they are carefully machined to a uniform depth, and even then the blades are not so secure as when each is held by a separate set of screws. The best plan is to supplement the clamp by some other holding means, such as side screws, as in the case of the Bardons & Oliver multiple cutting-off holder for the rear of the cross-slide, as shown at *C*, Fig. 17. The side screw or screws, in case more than one is used, serve to hold the tools and filler pieces securely in place.

In some cases, however, it is desirable to apply two clamps to one blade, as is done on the Bardons & Oliver holder shown at *B*, Fig. 16. The lower stud obtains a firm lateral grip on the cutting-off blade. Another variation consists in using one clamp for two settings. This is often done to obtain right- and left-hand cutting positions for the tool. A cutting-off tool-holder of this type, with grooves on each flank and a reversible clamp, is shown at *D*.

One advantage of the clamp method of fastening is the facility with which it can be specially formed to locate and grip the tool or cutter. The simplest type of holder for holding and locating the cutter is one designed for a round cutter employed for turning operations, such as the one shown in the two views at *D*, Fig. 17. This holder is part of the equipment of a shaft-turning lathe.

Tongued joints provide another means of holding tools or cutters in place. This type of holding means is employed on the Pratt & Whitney threading holder shown at *E*, Fig. 16. This holder has a vertical adjusting screw, which engages a segment thread on the corner of the cutter. Single- and multiple-tooth chasers and offset types of cutters can be used in this holder.

A V-clamp forms a convenient means of securing cutters that must be drawn down on a bed or surface, as in the case of dovetail forming tools, such as shown at *F* and *G*, Fig. 16. The holder shown at *F* has a plate clamp and two clamping screws, while the holder shown at *G* is provided with a bolt clamp, having the stem or bolt end machined integral with the clamping head. The Landis tangential chasers are also gripped by a special shape

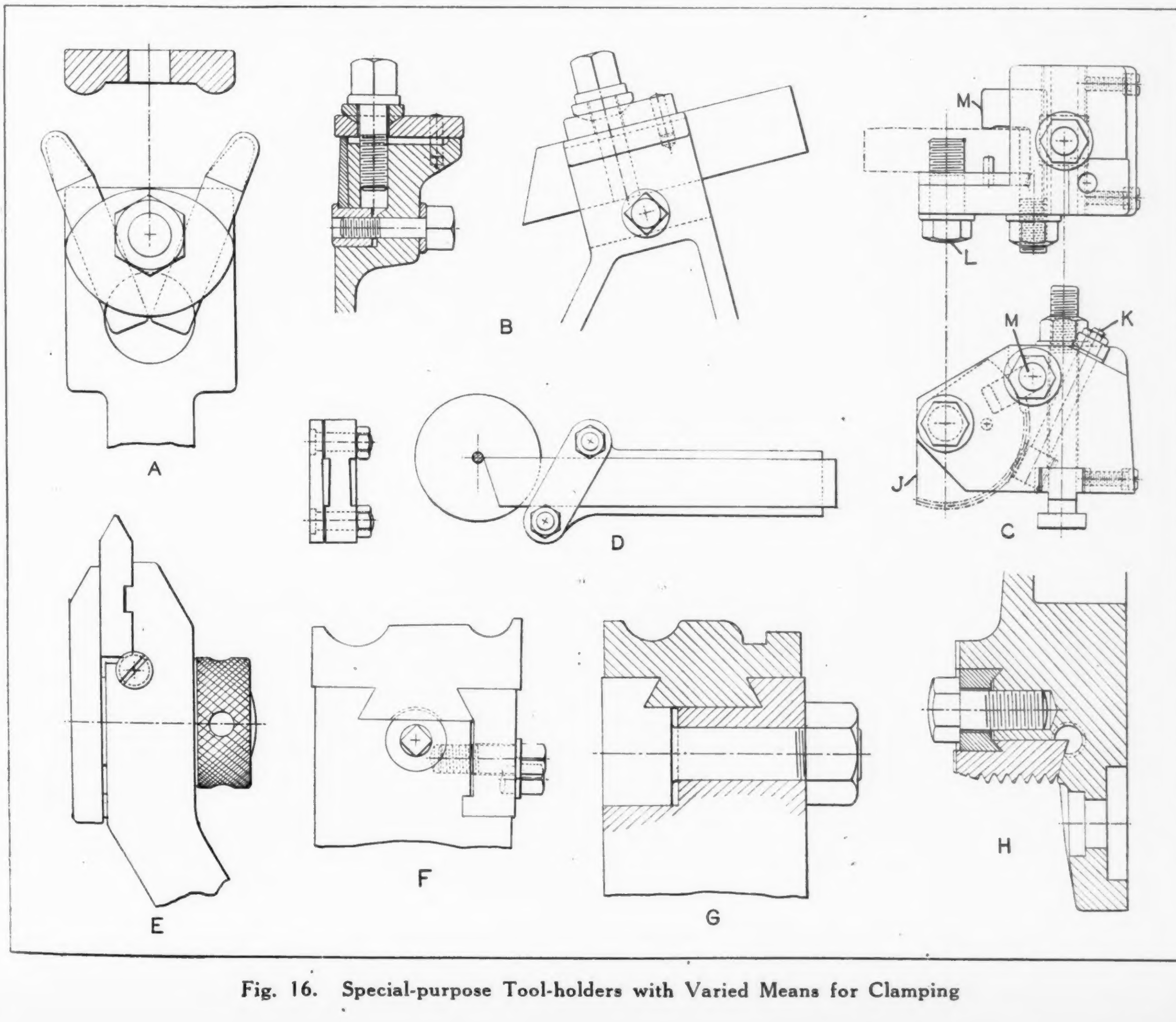


Fig. 16. Special-purpose Tool-holders with Varied Means for Clamping

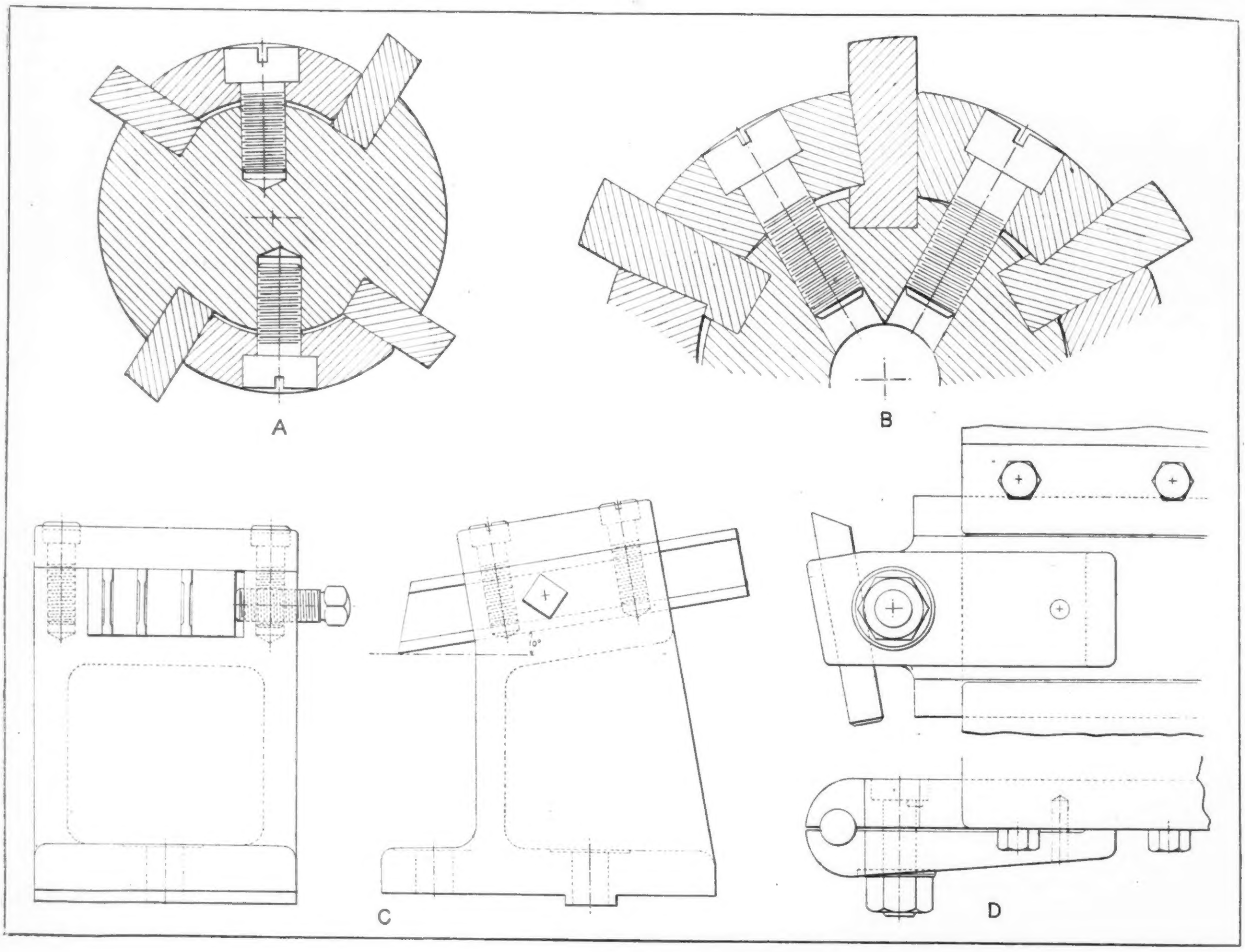


Fig. 17. Methods of Holding Cutters in Rotating Heads and in Fixed Tool-blocks

of clamp, as shown at *H*, and are provided with an end adjusting screw. Forming tools such as shown at *F* and *G* also require screws for making endwise adjustments and to prevent slipping.

The hook-bolt type of clamp is particularly useful as a means for holding circular form tools. This type of clamp is used on the Brown & Sharpe holder shown at *C*, Fig. 16. The tool-holding member *J* has a worm-wheel sector which meshes with a worm-shaft *K*, by means of which the tool-block can be rotated on the stud *L* to bring the point of the tool into the required position. The hook-bolt *M* serves to hold the tool securely against the side of block *J*. Clamping bolts with slotted heads, such as shown on the boring head *A*, Fig. 19, are also satisfactory for many turning and boring tool-holders.

Some boring-bars, especially those used in turret lathes, are designed to employ a clamping washer and screw as a means for securing the cutter. Pressure is transmitted to the cutter by the washer through a sleeve of the required length. An arrangement of this kind is shown at *B*, Fig. 19. In some cases, the clamp may exert pressure on one or more pins, which grip the tool at an angular position, where the direct type of clamp could not be conveniently employed. A pin may also be used as the only clamping means, as is the case in the McCrosky reamers, where the pin lies against a groove in the blade and is forced against the blade by a taper-nosed screw, as indicated at *G*.

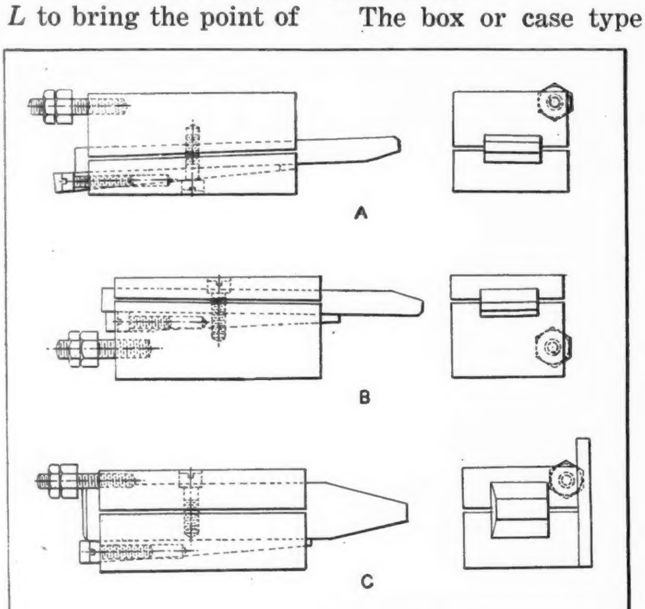


Fig. 18. Upper, Lower and Center Tool-holders employed on Gear Planer

The box or case type of clamp offers another means of holding the cutter or tool that is particularly desirable for cutters made from stellite. Practically complete enclosure of the cutter may be obtained with this type of holder, as shown at *D*, Fig. 19, in which the base portion is carried out beyond the remainder of the holder, in order to provide a rigid support directly under the cutting lip.

The case clamp may also be used for cutting-off tools, with the additional feature of angular joints designed to lock the blade with a downward and sidewise pres-

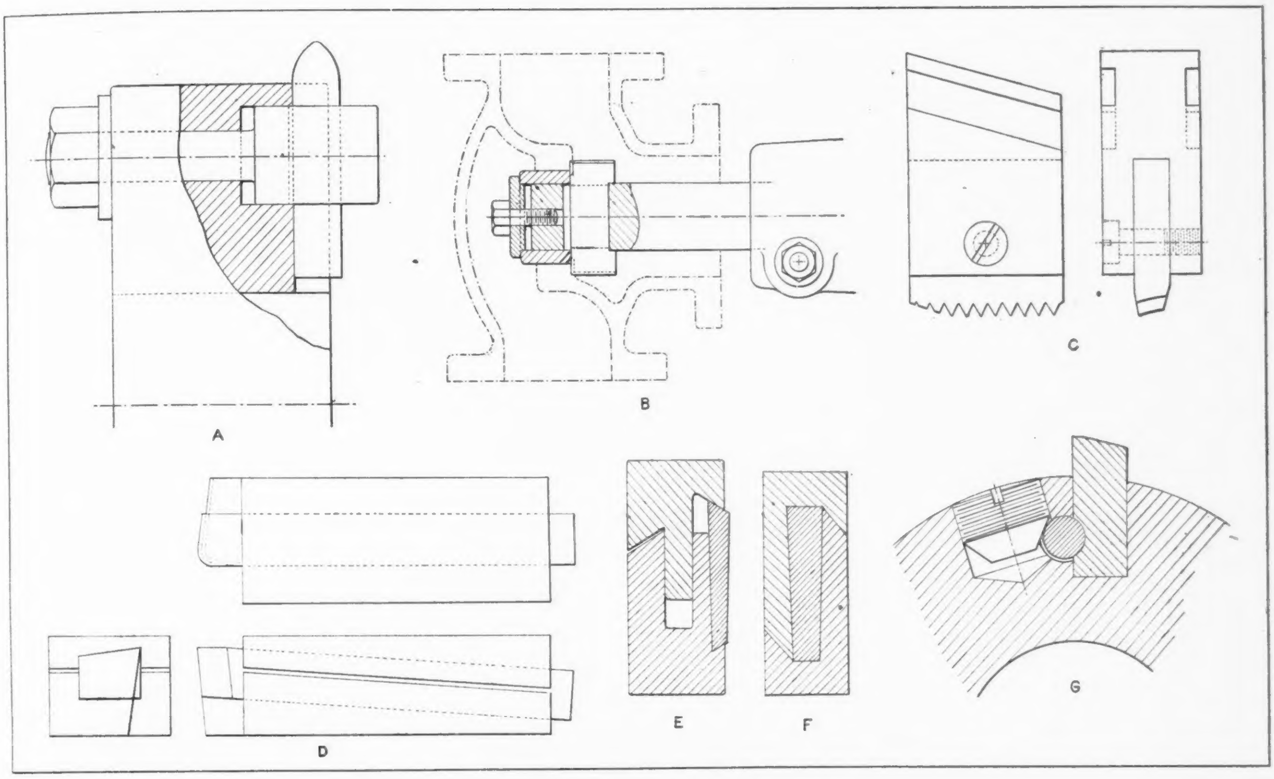


Fig. 19. Tool-holders Designed for Special Purposes

sure, as in the case of the Ready Tool Co.'s parting tool shown at *E*, Fig. 19, and the Western Tool Co.'s holder shown at *F*.

The case type of holder is also used where the tools must be held or adjusted in a special manner, as in the case of dies for screw machines. For work of this kind, the dies may be held in angular grooves cut in the case, as shown at *C*, Fig. 19. In Gleason gear planers, the upper, lower, and center holders are fitted with adjusting wedges and end adjusting screws, as shown at *A*, *B*, and *C*, Fig. 18.

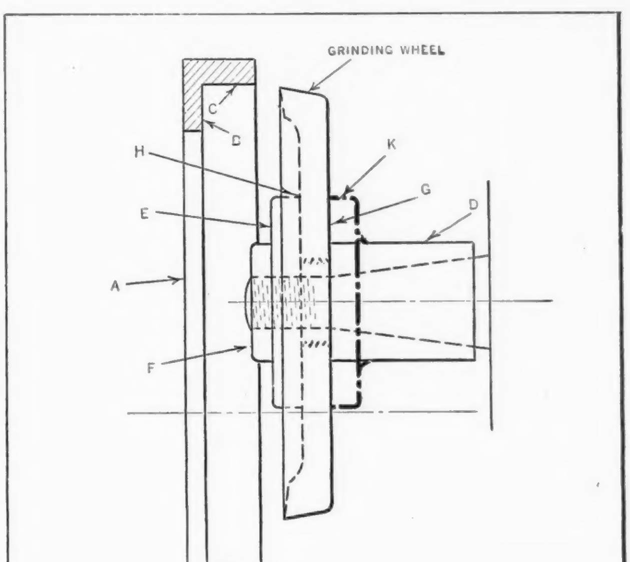
* * *

GRINDING INNER FACE OF RING

By JOHN W. HODGSON

To insure safety, the writer would like to make a suggestion regarding the special spindle arrangement for grinding the inner surfaces of a ring, shown on page 291 of December MACHINERY. The tapered collar for carrying the grinding wheel out near the end of the spindle, as shown in December MACHINERY and by the full lines at *D* in the accompanying illustration, should be provided with a flange, as indicated by the heavy dot-and-dash lines at *K*. This flange should have the same diameter as the collar *E*.

Without the flange, a slight over-tightening of the nut *F* is likely to break the wheel at *G*, because of the pressure exerted against the wheel at the outside edge *H* of the collar *E*. The breaking of a grinding wheel is almost sure to cause injuries to anyone standing near the grinding machine, and every precaution should be taken to prevent this from occurring.



Wheel-spindle Equipped for Grinding Ring

* * *

ENGINEERING RESEARCH FELLOWSHIPS

To assist in the conduct of engineering research and to extend and strengthen the field of graduate work in engineering, the University of Illinois maintains sixteen research graduate assistantships in the Engineering Experiment Station at Urbana, Ill. These assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering, physics, or applied chemistry. Additional information may be obtained from the Director, Engineering Experiment Station, University of Illinois.

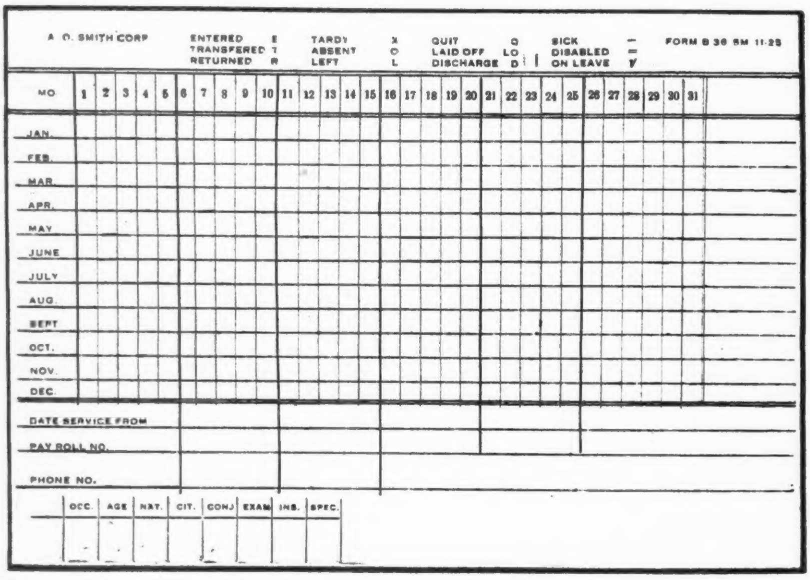
* * *

Technical schools and colleges giving summer courses or evening courses in mechanical engineering and management, are requested to send information relating to such courses to MACHINERY, for announcement in the editorial columns.

Maintaining a Live Record of Employes

EVERY large industrial concern experiences periods of business depression, which necessitate reducing the working force temporarily. When such an occasion arises, men are likely to be laid off more or less indiscriminately unless an accurate record has been maintained of their service to the company. If such a record is not kept, certain factors will be forgotten that bear a definite relation to the efficiency of the men. Similarly, when increases in wages or promotions are in order, it is desirable to have a reliable record of the men.

The employment department of the A. O. Smith Corporation, Milwaukee, Wis., uses the card here illustrated for keeping a daily record of each employe. This card shows at a glance on which days a man was absent from work during a given year and why. Whenever an employe is away two days, without leave, an investigation is made, and sick or injured employes are visited by the company nurse during their period of disability. On the same card are also recorded the days when a man is late. Other uses of the card are to show the date on which a man was hired, transferred from one department to another, discharged, etc. The card is filled in from slips sent to the employment office every morning by the shop foremen.



Form Used in an Employment Department for Keeping a Daily Record of Each Employe

When it becomes necessary to lay off men because of business conditions, the file of these cards is gone over carefully and those men are dismissed whose cards show them to be the least dependable. The cards are also referred to when increases in wages are being considered or when employes ask certain favors.

One other record of employes is maintained in the employment office and filed with the card just described. This card is used to record such information as the nationality, age, physical defects, and education of the man. There are also columns for recording the progress of the employe in the organization, his rate of pay, check number, etc.

Keeping Tabs on the Labor Market

A daily record is kept of the number of applicants for work, so as to obtain an accurate knowledge of the labor market. The applicants are classified according to whether they are skilled, semi-skilled, or unskilled and also according to age. From this record an idea can always be obtained of the volume of unemployed in the environs of Milwaukee at a given date. Any employment manager may have a theory of labor market conditions, but with such a record it is possible to give definite figures. Records are also maintained of the number of men hired daily from each of the classified groups.

Whenever a new man is taken on in this plant, he is given a leaflet containing the shop rules. This leaflet helps to assimilate new men in the organization, as it explains many things about the plant that a new employe ordinarily learns only after working a considerable period of time for a concern. Each new employe is also given a leaflet pertaining to safety regulations, and men assigned to power presses are given a special leaflet dealing with the safe operation of these machines. Each of the safety leaflets must be signed by the new employe and his foreman. In the event that an accident occurs and there is no signed receipt for safety instructions filed in the employment department, the foreman of the injured man is held partly responsible for the accident. Every foreman has the opportunity of rejecting a man hired for his department.

Interviews are Given to All Employes Discharged or Quitting

No employe is laid off or dismissed unless such action is approved by the employment office. Similarly, if a man decides to quit, he is not given his pay until he sees the employment manager. When a man is discharged, he is usually incensed at someone in authority, and this interview gives him an opportunity of stating his views to a responsible member of the organization. The employment manager can then tactfully explain the reasons for discharging the man, and after such an interview, the former employe is less likely to hold a permanent grudge. Men laid off temporarily are assured by the employment manager that they will be re-employed just as soon as business conditions warrant.

It is fully as important to interview men leaving of their own accord, because this practice keeps the employment manager in close touch with condi-

tions in the shop. Frequently, a man decides to leave because the work is unsuited to him, but pride makes him keep the truth to himself. Such a man can often be transferred to another department with the consent of his previous foreman. When there are minor misunderstandings between the foremen and employes, they are brought together in the employment office and the matter settled amicably, but the interview must be handled in such a manner that the employe realizes that the foreman is master of the situation.

Essentials of Successful Hiring

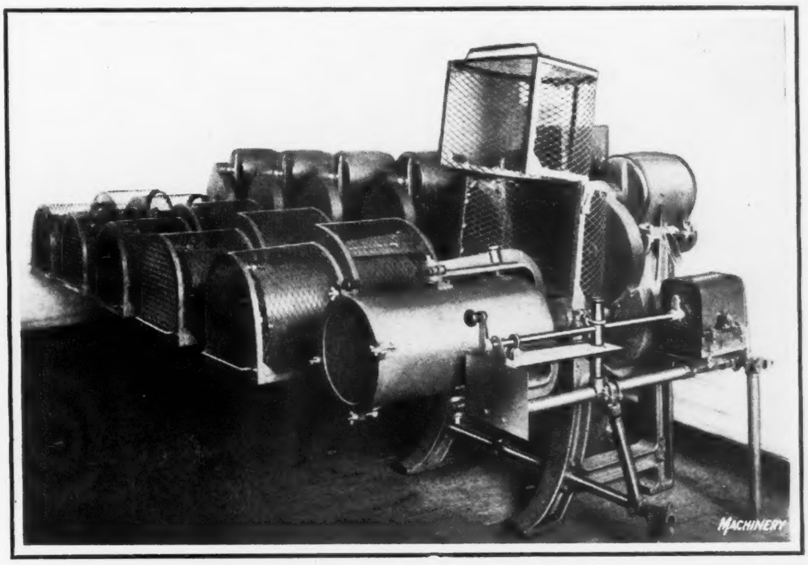
No employment department can be truly successful unless the men who interview and accept applicants are tactful, practical, and good judges of human nature. The work of such a department consists not merely of hiring to meet the demands of a plant, but of hiring intelligently so as to keep labor turnover at the lowest possible level. Anyone can hire a man to fill a given job, but it is a more difficult proposition to hire a man who will fill that job efficiently, contentedly, and steadily.

* * *

SAFEGUARDING TUMBLING BARRELS

All likelihood of injury to the operator or to passersby, from the battery of tumbling barrels here shown, has been eliminated by providing wire-mesh guards. Each one of these tumbling barrels is driven by an individual motor, but can only be rotated when the guard is lowered over the barrel. This is because the electric circuit to the motor is broken whenever the guard is raised. As the guard is again lowered, the circuit is automatically connected.

These tumbling barrels are 12 inches in size, and are installed in the switchboard department of the Schenectady, N. Y., plant of the General Electric Co.



Tumbling Barrels Equipped with Guards that must be Lowered before the Barrels can be Started

* * *

INDUSTRIAL STANDARDIZATION IN 1926

Great developments were made in industrial standardization, especially in the mechanical and mining industries and in industrial safety, during 1926. According to a statement issued by the American Engineering Standards Committee, 29 W. 39th St., New York City, instead of permitting standardization work to become a more or less incidental function of the engineering and production departments, leading industrial executives are more and more providing a definite organization for standardization work.

This systematic organization of company standardization work is gradually leading to a larger degree of cooperation between companies. For example, in the Cleveland industrial district, the men in charge of this work in a large group of important plants have organized for mutual assistance. Through this cooperation, more than thirty Cleveland firms have reorganized their screw thread practice in accordance with the revised national standard, and more than a dozen firms have systematized their entire method of interchangeable manufacture, through the introduction of the new national standard limits for gages.

Standardization work is also assuming international proportions. In April, there was held in New York the most important group of international conferences on standardization so far undertaken. In connection with these meetings, there were conferences on screw thread, ball bearing, and gage standardization. Real progress was made toward bringing about international uniformity in industrial practice in the different countries of the world. Twenty countries in Europe, Asia, and South America were represented. During the conference a basis was also laid for what it is hoped will soon become an international standardizing body, covering the general field of industrial standardization.

The fifth year of Mr. Hoover's Division of Simplified Practice records a steady development. About fifty simplification projects have been carried through, including a wide range of manufactured products, ranging from bed springs to shot gun shells, and from milk bottles to range boilers. In a survey of nineteen of these commodities, it is stated that from 51 to 99 per cent of the sales are in accordance with the simplified practice recommendations, the average for the nineteen lines being 79 per cent.

The work of the sectional committee on the tooth form of spur gears has been completed, and has been submitted for final approval to the American Engineering Standards Committee. Several sections of the comprehensive work on bolt, nut, and rivet proportions, pipe flanges and fittings, and T-slots are now also completed. The work on mechanical standards, now in course of development under the procedure of the American Engineering Standards Committee, is so extensive that plans are under way for the organization of a representative advisory committee whose duty it will be to keep the various parts of the work properly coordinated.

Annealing Malleable Iron Castings in an Oil-burning Furnace

By C. CHESTER MARK

ANNEALING is essentially a long drawn out heat-treatment designed to produce tough and ductile malleable iron from hard castings. This change is brought about by changing the pearlite and cementite of the iron to ferrite and temper carbon, which is done by heating the castings up to the temperature at which the cementite breaks down into iron and carbon. For furnace malleable castings, produced under the methods in use up to within the last few years, the temperature was maintained at around 1450 degrees F. However, furnaces of later design and the knowledge obtained by scientific research have made it possible to increase the maximum temperature to 1600 and even to 1650 degrees F., thus greatly reducing the time required for annealing.

Appearance of Malleable Castings

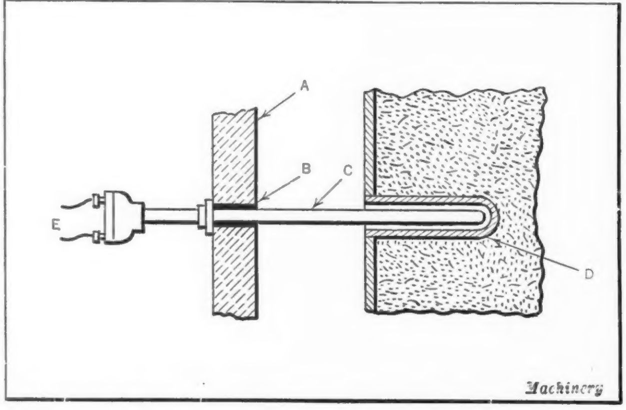
Malleable iron usually has a white outer band, approximately 1/64 inch thick, followed by a dark gray band and a velvety black interior. As the annealing proceeds, the steel band around the casting becomes thicker and the gray band thinner. When thin pots are used in one part of the oven and thick pots in another, other factors remaining the same, the castings in the thin pots will have a thicker band of white than those in the thick pots. In other words, the temperature of the castings within the pots is what counts—not the furnace temperature.

Locating Annealing Pots in Furnace

It is practically impossible to obtain exactly uniform heating with the older designs of furnaces. Some parts will be found to operate at lower temperatures than others. For example, where the oven is fired at the end, the temperature of the pots in the first row at the opposite end from the burners will be found to be lower than the others. Thin pots may be used in these sections of the furnace to obtain more uniform results and overcome the furnace defect. This provides a graduation of pot placement, and is of considerable importance when one considers that the life of the ordinary annealing pot ranges from about twelve to eighteen heats.

Packing Castings

Considerable inconvenience and loss may be eliminated by packing the annealing pots so as to compensate for some of the irregularities in furnace operation. In the first place, the castings must be embedded thoroughly in the scale. Every possibility of the castings settling down in the pots when subject to the heat of the furnace must be avoided by packing them level with a good quantity of scale between them. Air must be excluded, particularly air pockets. Air pockets adjacent to a casting permit considerable oxidization of the casting, burning off of thin sections and rounding of the casting edges. The luting must be secure and thorough, to exclude the air. Heavy castings must be kept track of, and the pots containing them should be located in the hotter portions of the furnace, allowing the pots containing the light castings to go into the cooler portions.



Pyrometer Installation in Annealing Furnace

Determining Temperature of Castings

The temperature of the castings is the important index, and the temperature of the oven itself does not give us the information needed for satisfactory results. In spite of this fact, the pyrometer is often placed through the brick work of the oven only, where it is of little practical value. The illustration shows how a pyrometer should be inserted in the annealing pot near the furnace wall. The wall of the annealing oven *A* has a cast-iron sleeve *B* in it, to receive the pyrometer "Nichrome" tube *C*. The pyrometer has a cast-iron tube *D* placed over the end of the "Nichrome" tube *C* within the annealing pot and within the vicinity of the work contained in the pot. The opening in the pot around the pyrometer, and the opening in the furnace wall are luted with clay. The wires *E* of the pyrometer are connected to a recording instrument, which is conveniently located. In this manner, the temperature around the castings is determined during the heat, and adjustments of the firing made accordingly.

Installation of Pyrometers

Obviously, there should be more than one thermo-couple in use in a good size oven. The exact number to be installed depends upon the oven construction. In case the action of the oven is definitely known, a single thermo-couple may be sufficient to govern the heat; however, tests must first be made to determine the uniformity of the oven temperature. This leads to adjustment of the openings to obtain more uniform heat. The installation of four

or five thermo-couples in the oven during these trials facilitates the work of adjusting, and eliminates guesswork.

The practice of extending the thermo-couple into the pot, as shown in the illustration, makes the life of the instrument shorter than when it is inserted just through the brick work of the oven; however, it is believed that the added expense is warranted. The small expense of a thermo-couple, as compared with four or five thousand dollars worth of castings, is an insurance against failure that cannot be disregarded.

The pot usually selected for the reception of the thermo-couple is located in the coldest part of the furnace, that is, in the first row opposite the firing end of the oven. The thimble *D* is placed in the pot at the time of packing, and the pot set in the furnace with the thimble lined up with the hole in the furnace wall. The thermo-couple is then projected through the wall into the pot, and the luting is completed before more pots are set.

While on the subject of thermo-couples, it might be well to mention the importance of the instrument in supervising the work. The ovens are placed under the control of a workman generally designated as a fireman, one for the day and one for the night shift. Unless pyrometers are used in connection with recording instruments, the word of the fireman must be relied upon. The pyrometer provides a positive check on the fireman. The record shows the length of time the oven was at the annealing temperature, the length of time coming up, and the rate of cooling. It is not necessary to keep the record under 1000 degrees F., unless information relative to the temperature for other purposes is desired. Checking the lag in temperature between the oven proper and the center of the pot, and other important phases of furnace operation can be accomplished by the use of pyrometers.

Requirements of Furnace

A review of the present methods of firing ovens discloses many different plans. One is impressed by the thought that foundrymen are somewhat uncertain regarding the best procedure, and have not yet been fully successful in their attempts to produce an oven that would possess most of the characteristics referred to in the following. As pointed out in the preceding paragraphs, the temperature should be uniform throughout the oven. At the same time, every attempt should be made to bring the oven up to heat as quickly as possible. So far, this rate has been reduced to approximately twenty-four to thirty-six hours. Perhaps later it may be improved even more.

The oven should be held at a uniform temperature during the so-called "soaking" period. This period is approximately sixty hours in later designs of ovens, and it may even be reduced by further advances in practice. The ovens should be cooled slowly at first, following the soaking period. In recently designed ovens, the rate of cooling has been increased from 10 degrees per hour to 12 degrees per hour until a temperature of 1250 degrees has been reached, and then greatly increased. This reduces the total time required for the annealing process. Modern annealing ovens produce malleable castings in approximately seven days.

Economical Operation of Furnace

From an economical standpoint, we have the following points to consider:

Fuel Cost per Ton of Castings—Every hour cut from the annealing time reduces the cost of production. This item is influenced by the capacity of the furnace and its loading. In the modern furnace, fired with fuel oil, a consumption as low as 28 gallons per ton of castings has been reached, but the average fuel oil consumption per ton of castings will run closer to 35 gallons.

Labor Cost—The packing of the castings in the pots consumes the major portion of the labor connected with annealing. Approximately three times as many men are required to pack the pots as for other duties about the ovens. For example, one fireman is required for each shift of eight hours. This man is also entrusted more or less with the supervision of the ovens. One man will pack approximately five tons of castings per day. Some time will be required to load the pots into the furnace, remove, and dump them. Other labor, such as removing the castings from the dump and cleaning them, will be indirectly dependent upon the time of annealing and furnace design.

Maintenance Charges—These charges will depend directly upon the design of the furnace and the materials used in its construction. What may seem at first glance to be an economical construction may prove to be expensive from a maintenance standpoint, thereby increasing the ultimate cost of production considerably above the estimates. The approximate maximum temperature obtained within the furnace, to which the refractory is subjected, is 1750 degrees F. With oil fuel there is some deleterious action of the oil flame on the refractory. Recently it was discovered that the ordinary oil fuel contains salt in sufficient quantities to make it a problem of great concern. The brick seems to wash down, and those familiar with oil furnace operation have, no doubt, noticed the collection of glass at the bottom of the furnace. The first noticeable trace of fluxing action on the firebrick is the brown glaze over the face of the brick. A "washing down" of this glaze soon follows, making it of paramount importance that a refractory be used which will resist this fluxing action of the oil.

This action of the oil on the brickwork of the combustion chamber must be taken into consideration in the design. In the ordinary oil-fired forge shop furnace, instead of employing a high-priced refractory, there is a general tendency to provide a target wall of considerable thickness at the beginning, in order to produce a combustion chamber of long life. It is advisable, however, to use a refractory that will be effective in resisting the action of the alkalis in the oil.

The overheating of the refractories is likely to occur when fuel oil is used, and this tends to increase maintenance costs. Overheating with fuel oil is difficult to prevent, because it is highly concentrated, possessing as many heat units per cubic foot as 1000 cubic feet of natural gas or 7000 cubic feet of producer gas. It is apparent, therefore, that the slightest increase in pressure on the oil lines, the least increase of the valve opening, or the least increase in the size of the orifice will re-

sult in a considerable increase in the amount of fuel injected into the combustion space. As the oil is atomized, it bursts into flame readily, resulting in rapid combustion and therefore localization of the heat. It is principally this factor that has caused the burners to be placed in the crown of the furnace, so that the flame will shoot down upon the tops of the pots which are, in turn, protected by a covering of slag.

Life of Annealing Pots—The average life of annealing pots is very low; however, the most logical manner to compare pots is on the tonnage basis. The average pot will produce from 8 to 10 tons of malleable iron before it must be discarded. The general cause of discard is breakage. However, there are many pots that become too thin before they break, and the thickness of the pot wall should, therefore, be the determining factor in discarding it. The pot metal oxidizes when subjected to high temperature in the presence of a large volume of air, such as encountered in the annealing oven. In the intermittent type of oven, the pot is probably shorter lived than in the continuous type of annealing oven. This is said to be due to the fact that higher temperatures must be maintained in the intermittent oven, in order to obtain the required annealing temperature in all parts of the oven. The pots subjected to the higher temperature, will, of course, deteriorate more rapidly than those located in the cooler parts of the furnace.

The life of the annealing pots is influenced to a considerable extent by the condition of the firing. In this regard, oil fuel possesses a decided advantage over solid fuel to the extent that large volumes of air can be excluded from the oven. The amount of air required for combustion of the fuel can be regulated to more nearly conform to the requirements of oil fuel than coal or coke.

* * *

MILLING WITH SCREW-FED FIXTURES

Electricity, as is well known, is commonly supplied to trolley cars through a wire supported by cross-wires running from poles located on opposite sides of the street. The connection between the cross-wires and the feed wire is usually made by means of a brass casting having a long slot in which the feed wire is held. One of the unusual operations in the machine shop of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., consists of milling a slot 15 inches long, 3/8 inch wide, and 33/64 inch deep in these castings, or "trolley ears" as they are called. The operation is performed on a horizontal spindle milling machine equipped with fixtures that are fed past the cutters by lead-screws mounted on top of the machine table. The table always remains stationary.

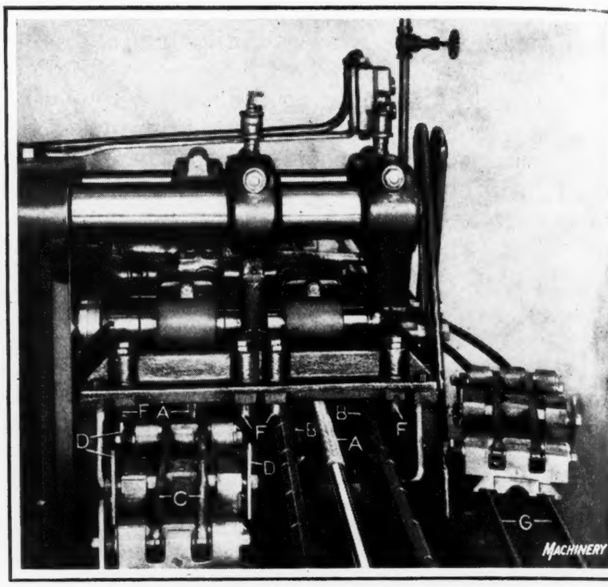


Fig. 2. View of Machine, Showing the Two Lead-screws for Feeding the Work Past the Cutters

The lead-screws may be seen at *A*, Fig. 2. Two ways *B* on each side of the screws guide the fixtures in a straight line along the table. Two trolley ears are held in each fixture by clamps *C*. The loaded fixtures are taken from tracks *G*, placed on ways *B*, and pushed along the ways until a half-nut on the bottom of the fixture engages screw *A*.

The clamps which hold the work in place are automatically tightened as three fingers *D* on one side of the fixture and a fourth finger on the opposite side strike the spring-actuated plungers *F*. When the work is past the cutters, the fingers are knocked in the opposite direction to unclamp the work.

Four cutters are mounted on the arbor to mill four pieces held in two fixtures. The cutters rotate at the bottom in the same direction as that in which the fixtures are fed. At the completion of the operation, the fixtures are lifted to track *G*, which may be clearly seen at the front of the table in Fig. 1. The fixtures are then reloaded and pushed along the track to the end of the machine shown in Fig. 2. The production averages 160 pieces per hour.

Soda water is pumped to the cutters and flows with the chips back to a settling tank. The water is strained and repumped to the cutters, while the chips are carried by a screw conveyor into a receptacle.

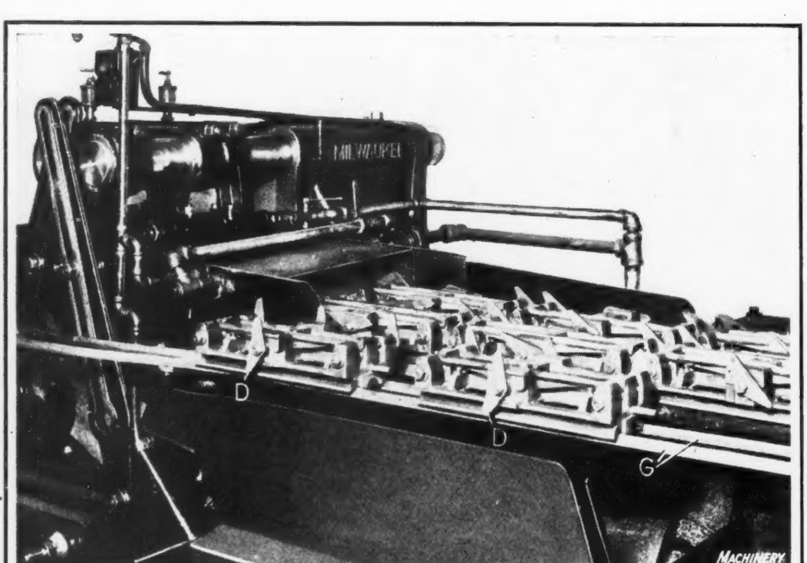


Fig. 1. Machine and Fixtures Used for Milling Slot in "Trolley Ears"

What is a Patentable Invention?

Nature of Improvements that Constitute Invention—When Old Elements and Simplified Designs are Patentable

By LEO T. PARKER, Attorney at Law, Cincinnati, Ohio

One of the most difficult matters to decide in regard to inventions is the question of what is really patentable. Many inventors have wasted their time developing devices that could not be adequately protected by patents, and in some cases, industrial firms have invested large sums in patents that subsequent litigation has proved to be worthless. While the Courts generally have to pass upon whether or not an invention is patentable and a patent valid, there are a number of fundamental principles that the inventor or the manufacturer can apply for himself to determine, in a general way, whether or not a valid patent can be obtained. The present article points out several of these principles, which are not generally understood by mechanical men or manufacturers. A study of this article, therefore, will prove of considerable value to inventors or others who may be interested in patent matters.

IN view of the numerous previously decided patent litigations, in which patentability of inventions has been the chief point of discussion, it is certain that the opinions of the learned specialists in patent laws have been about evenly divided on the subject; and many of our most valuable inventions have presented very difficult problems for the Courts in regard to whether or not they were the proper subjects of valid patents.

Broadly speaking, any invention is patentable, irrespective of its simplicity, provided it is novel and useful and the inventive faculty is exercised in perfecting it. On the other hand, with patented things of extremely simple character, the question invariably arises as to whether or not the invention or discovery actually is a patentable invention. Any new device or article is an invention, but perhaps not a patentable invention. Therefore, there is a fine line of distinction between patentable and unpatentable things, and to determine on which side of the line a particular invention lies may require the most competent experts in the profession. Quite often a final decision of the higher Court means millions of dollars to the inventor or owner of the patent in litigation.

For this reason, the question of simple patentable and non-patentable inventions will be considered in this article in a manner that should prove informative to the manufacturer, inventor, and professional specialist in patent law.

Simple Change Makes Valuable Invention

Probably one of the hardest fought and most expensively conducted patent litigations was on the well-known barbed wire fence. (143 U. S. 277) The high value, extreme simplicity, and efficiency of this invention resulted in various manufacturers and patent lawyers expending immense sums and exerting their utmost ability in attempting to have the patent declared invalid. For the same reason, equally able lawyers and wealthy manufacturers defended its validity. The litigation of this patent passed through the lower United States Courts, and finally was brought before three or four of the Circuit Courts of Appeals. Some of the latter Courts declared the patent valid, and others rendered conflicting decisions. The litigation was then carried into the United States Supreme Court, where the various controversies were considered collectively. After thorough litigation, the patent was declared valid and infringed.

The fact that this decision involved many millions of dollars, and is so important in determining the line that separates patentable and unpatentable inventions is sufficient to render it worthy of careful consideration. And it is a simple invention, well known to everybody. Moreover, the expressions used by the Courts in the opinions have been copied and cited in more than two hundred patent infringement litigations that involved all kinds of inventions in recent years.

The invention consists primarily of combining, at intervals, a plurality of short sharp-pointed wires with two twisted ordinary fence wires. The short wires, or barbs, are wound about only one of the long wires. That is the important phase of the invention. The long wires, being twisted, maintain the barbs in stationary position with relation to the twisted wires. Also, if the barbs become loose, the long wires may be twisted by the user of the fence, which tightens the pressure that maintains the barbs in their respective positions.

Various and numerous inventors had obtained patents on barbed wire fences previous to the invention of the patent in litigation, and the use of barbs in combination with two or more twisted wires for fences had been common for many years before the patentee conceived his invention. But the exact words used by the Court in explaining the similarity of the invention in controversy and other prior inventions convey the desired information satisfactorily. They are as follows:

"The use of wire fences, composed either of a single wire, or two or more wires twisted together, antedates by many years the barbed feature of such fences. But, either by reason of their comparative invisibility or their weakness, they proved an insufficient protection against cattle, and fell largely into disuse. Something was needed, not so much to strengthen them, as to deter cattle from encountering them or testing their strength. Natural hedges of thorn, which, in effect, contain the principle of the barbed wire, have been employed

in both this country and in England from time immemorial. Fences of other materials and various forms had been armed with pickets, spurs, iron points, spikes, sharp stones, or bits of broken glass inserted in plastic, but prior to 1867 no one seems to have conceived the idea of arming wire fences with a similar arming device. In July of that year, however, one William D. Hunt took out a patent for arming the wires with a series of small spur wheels, their spurs being sharpened so as to prick readily. These wheels were provided with openings at their centers through which the wires passed, fitting loosely so that the wheel would revolve loosely upon it. There was a provision, sometimes used and oftener not, for keeping the spurs in their places, and at suitable distances apart, by means of flanges. This was obviously a crude and unsatisfactory device, and never seems to have gone into general use. The spurs were small serrated wheels revolving loosely about a wire, aided by flat bits of metal to render them more readily visible, and kept in place, if at all, by a clumsy kind of expensive flange.

Many Minds Usually at Work on Same Invention

"In the same year, and about four weeks before the patent to Hunt, although his actual invention was antedated by Hunt in point of time, Lucien B. Smith took out a patent for a wire fence having spools of iron and wool strung upon it, each spool being perforated and provided with four spurs projecting radially from them, and so arranged that they would revolve, while they were held in place lengthwise of the wires by slight bends or deflections in the wires at a distance of two or three feet apart forming short straight lengths of about four inches, upon which the spools were hung. This patent contained the first suggestion of a barb proper, though in a very imperfect form; but it embodied an idea, of which the public was not slow to avail itself, and gave an impetus to succeeding inventors, which finally resulted in the barbed fence now in use. Though valuable as illustrating the state of the art, it will scarcely be claimed to be an anticipation of the Glidden device.

"The patent of February 11, 1868, to Michael Kelly indicated a decided step in advance of its predecessors, consisting, as it did, of small flat pieces of iron or steel, cut from a plate by machinery, each provided with a hole corresponding with the size of the wire, though a little larger, so that they could be introduced upon the wire. 'These pieces,' says the patentee, 'after being strung on wire at distances about six inches apart, are compressed laterally upon the wire by a blow of a hammer, or otherwise, so as to flatten the hole, and also correspondingly flatten the wire at the point where this adjunction is to stand. I term these pieces "thorns"; and it will be observed that each presents two sharp points. They may be so placed that they will all stand in the same plane; or they may stand irregular in many different planes.' "

It is the Last Step that Wins

It is easy to realize that many different kinds of barbed devices were used long before the invention of the present barbed wire fence. In holding this patent valid and infringed, the Court said:

"It is true that the affixing of barbed wires to a fence wire does not apparently give a wide scope to the ingenuity of the inventor, but from the crude device of Hunt to the perfected wire of Glidden, each patent has marked a step in the progress of the art. The difference between the Kelly fence and the Glidden fence is not a radical one, but slight as it may seem to be, it was apparently this which made the barbed-wire fence a practical and commercial success. The inventions of Hunt and Smith appear to be scarcely more than tentative, and never to have gone into general use. The sales of the Kelly patent never seem to have exceeded 3000 tons per annum, while the manufacture and sale of the Glidden device (sharp barb substituted for a blunt one) rose rapidly from 50 tons in 1874 to 44,000 tons in 1886, while those of its licensees in 1887 reached the enormous amount of 173,000 tons. Indeed one who has traveled upon the western plains of this continent cannot have failed to notice the very large amount of territory enclosed by these fences which otherwise, owing to the great scarcity of wood, would have to be left unprotected.

"Under such circumstances Courts have not been reluctant to sustain a patent to the man who has taken the final step which has turned a failure into a success. *In the law of patents, it is the last step that wins.* It may be strange that considering the important results obtained by Kelly in his patent, it did not occur to him to substitute a coiled wire in place of the diamond shaped prong, but evidently it did not; and to the man to whom it did, ought not to be denied the quality of inventor. There are many instances in the reported decisions of this Court where a monopoly has been sustained in favor of the last of a series of inventors, all of whom were groping to obtain a certain result, which only the last one of the number seemed able to grasp."

However, for the purpose of strengthening the offense, the opposing counsel, in a determined effort to have the barbed wire fence patent declared invalid, introduced evidence that tended to prove that exactly the same invention disclosed in the patent had been made and used many years before its invention by the patentee. If this testimony had been sufficiently convincing, the Court may have held the patent invalid on the grounds that it was anticipated. But the rule of the law is well established that the validity of a patent cannot be destroyed simply because the same invention was made and used previous to the conception thereof by the patentee, especially if the first inventor abandons it. And although during the barbed wire fence patent litigation, about forty witnesses testified that another inventor had made and exhibited, at a County Fair, a barbed wire fence of similar structure, the evidence was not effective.

Abandoned Invention Not Considered Important

When the Edison incandescent electric light patent, the Bell telephone patents, and many others, were adjudicated in the Courts, conflicting evidence was introduced that was intended to convince the Court that another inventor had invented and used the same invention long before it was discovered and patented by the holder of the patent. But it is

important to know that where an inventor merely conceives or makes an operative model and then abandons the discovery without obtaining a patent or putting the invention into practical use, these facts do not invalidate a patent obtained by a later inventor who knew nothing of the prior experiments and abandonment of the invention by the other party.

The Circuit Court of Appeals, Second Circuit, rendered a very important decision (170 F. 327) in which it was held that a patent for an invention will not be refused an inventor, nor will an issued patent be declared invalid, simply because testimony is introduced to show that a certain result had been accomplished previous to the invention of the patent in litigation, particularly unless the means for producing the result is thoroughly described.

In another case where the same point of the law was involved (228 F. 700), the Court held that the patent in litigation was not invalid simply because the opposing counsel introduced as evidence the drawings of a prior patent which incidentally showed a similar arrangement of the parts. The Court explained, further, that where an attempt is made to anticipate or invalidate a patent by means of drawings in a prior patent, the drawings must show an arrangement of the parts which is essential to the prior invention and designed or adapted or be used to perform the functions of the patent in litigation. In other words, simply because the drawings in a prior patent show a similar arrangement of the parts in the litigant patent is no reason for the later patent to be declared invalid, unless the two inventions were originally intended for the same or similar purpose.

Old Elements Are Patentable

Another important United States Supreme Court patent litigation relates to gearing (145 U. S. 156). In this case, the parties who opposed the patent attempted to show that it consisted merely of an assemblage of old and well-known parts which were shown in prior patent applications. It is interesting to note that in holding this patent valid and infringed, the Court said:

"It is not sufficient to constitute an anticipation that the device relied upon might, by modification, be made to accomplish the function performed by the patent in question, if it were not designed by its maker, nor adapted nor actually used, for the performance of such functions."

Many of the most valuable inventions comprise merely a combination of old and well-known elements. A patent on such a device is just as valid as if all the parts were new, because if by combining various old parts, a machine is constructed by which new and useful results are accomplished, it lies in the class of patentable things. (123 O. G. 863) In numerous cases, the Court held a patent in litigation valid and infringed, and explained that it is no defense to infringement that one or more elements or parts of the invention being infringed are found in various older patents or other publications, or elsewhere. And, further, that for old inventions to be the means of invalidating a patent, it is indispensable that the opposing counsel show that all the elements, or their mechanical equivalents, are found in the same description or machine, and that they do substantially the same work, by substantially the same means, as the invention disclosed in the patent in litigation. (See 207 F. 83, and 155 U. S. 597).

Device Composed of Fewer Parts Not Always Patentable

Occasionally there is presented before the Courts for discussion a patent on an invention comprising exactly the same parts shown and described in a prior patent, except that one of the parts is omitted. Where a patent is obtained on an invention that is exactly like an old invention with one of its parts omitted, the patent will not be held valid, unless it is shown to the satisfaction of the Court that by omitting the part, the device is caused to operate in a different or new manner. For example, a patent on a very valuable machine invention was adjudicated. The inventor had been paid more than $100,000 royalty by a single company for the use of the invention for a short period. This fact alone establishes beyond a reasonable doubt that the invention had great utility. This litigation was carried to the United States Supreme Court, and it is important to note that the patent was declared invalid. (159 U. S. 477) The Court explained as follow:

"After all, the invention resolves itself into the omission of the storage feature and a necessary incident thereto. To make a combination of old elements patentable, there must be some new result accomplished, and as the result in this case is a mere aggregation of the several functions of the different elements of the combination, each performing its old function in the old way, we see nothing upon which a claim to the invention can be based. The device is undoubtedly a convenient one, and appears to have proved profitable to the patentee, but we are unanimously of the opinion that it lacks the necessary quality of invention."

So it is apparent that while the general rule of the law is that infringement of a patent may be avoided by omitting an important element, yet a valid patent cannot be obtained on an old device by the omission of a part, unless the new invention is capable of producing new and useful results, or unless it operates in a different way. Recently a Court, in effect, said that taking an old invention and removing or omitting an important part is not the subject of a valid patent, particularly where the omission is made simply to avoid patent infringement litigation with the owner of a prior patent, although infringement actually is avoided.

Utility of Invention Strengthens Patents

Recently the Court aptly explained the chief requisite for a device to be the subject of a valid patent. This Court, in effect, said that whether a patented invention actually involves invention is determined by the important factor of whether the inventor has given the world something of value that it did not have, and the fact that the invention is a commercial success is greatly in its favor. And, further, that the determining factor, in deciding whether or not an invention is patentable, is not whether the achievement was difficult or easy. (262 F. 415).

Various attempts have been made to invalidate patents on the ground that the invention is so extremely simple that inventive faculty was not required to conceive it; but the Courts have held generally that the patentability of an invention cannot be determined by considering the task involved in perfecting or reducing the original idea to successful practice. In a recent case (6 F., 2nd, 1013) the Court said that any advance in the art, however slight, if it produces the result by purely mechanical means, makes the device patentable.

In another case (270 F. 695) the Court explained that an improvement or machine patent that produces a new and useful result or greater efficiency is the result of invention, even though after the invention was made, it would appear to many that anyone could have made it.

The smallest difference in the structure of two inventions, which causes one to produce noticeably better results than the other, receives the benefit of the doubt when the validity of the patent is being contested. In inventions of simplicity, the slightest improvement or difference in construction, material, operativeness, or the like is examined with considerable attention by the Court.

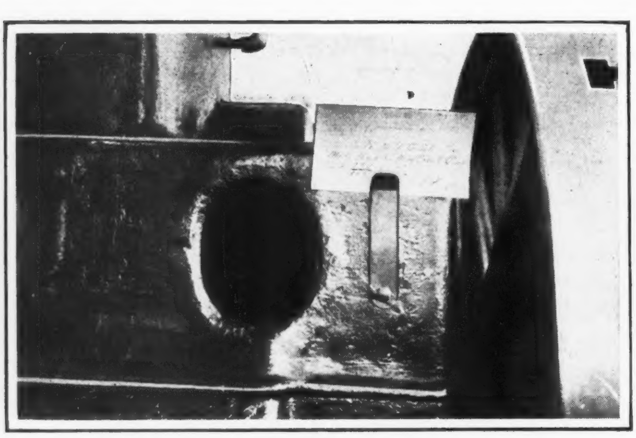
In connection with one of many simple and apparently trifling inventions, the Court said "This invention is simple and very like the prior art." (157 F. 156). And at another place the Court said, "The novelty of the device over the prior art is slight. Indeed the art itself is simple and is incapable it would seem of radical advances." Yet notwithstanding that the Court realized the extraordinary simplicity of the invention in litigation, the patent was declared valid and infringed, primarily because the inventor gave something to the world that it did not have prior to his invention.

* * *

CLIP FOR HOLDING WORK SLIPS

By J. R. PHELPS, San Bernardino Shops, Atchison, Topeka & Santa Fe Railway, San Bernardino, Cal.

A spring clip for holding work slips or sketches against the headstock of a lathe or in a convenient position on any other types of machine tools is shown in the accompanying illustration. These clips may be made from a piece of old scrap band saw. When small sketches or drawings are held in this way, they are always visible so that it is easier for a workman to avoid mistakes.



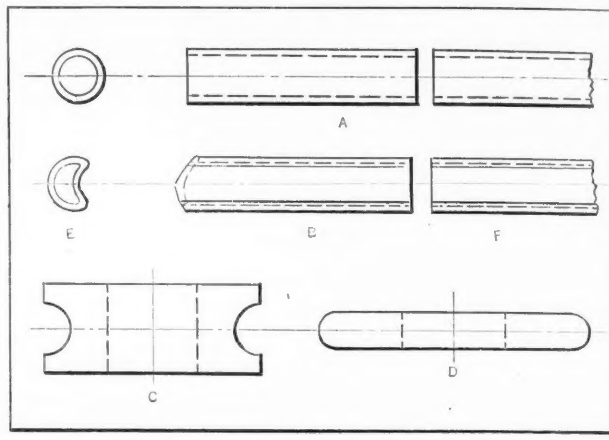
Spring Clip Attached to Lathe Headstock for Holding Work Slips or Sketches

DEEP-HOLE DRILLING

By C. G. WILLIAMS

The writer read with interest the description of a deep-hole drill on page 289 of December MACHINERY. To the writer's knowledge drills of the type described have been in use for many years in gun factories, and new types have in many instances taken their place.

In the year 1916, the steel mills began to make high-speed steel tubing which was suitable for deep-hole drills of small size. This new material



Deep-hole Drill and Rolls Used in Forming Drill

made it possible to make still further improvements in deep-hole drills, as shown in the accompanying illustration. The first step in making the improved drill was to run the tubing *A* through the set of rolls shown at *C* and *D*. The lower roll *C* has a groove corresponding to the outside diameter of the rough drill point, and the upper roll *D* has a contour that fits the chip groove of the drill. The cross-section of the tube after being rolled had the shape shown at *E*.

The rolled end *B* of high-speed steel was joined, either by electric or oxy-acetylene welding, to a soft steel tube *F* rolled to the same shape. In this drill, the oil flows to the point of the boring bit through the center of the tube, and returns through the recessed portion, carrying all the fine chips out of the bore. The speeds mentioned in the article in December MACHINERY were rather slow, as compared with the speed of some of the modern boring machines designed during the War. In some cases, speeds of 3500 revolutions per minute were employed, although generally a speed of 3000 revolutions per minute was used.

* * *

Eighty-one years service with the same firm is an unusual accomplishment, but this is the record of John Hughes, works manager of Messrs. George Salter & Co., Ltd., West Bromwich, England. Mr. Hughes is in his ninety-first year and still attends to his work daily. He does not merely put in an appearance in the mornings, but stays all day and takes an active part in the management of the business. He commenced his career with the Salter concern at the tender age of ten years. That he is still mentally as well as physically active is evidenced by the fact that soon after his ninetieth birthday he took out a patent for a spring balance which is manufactured by his firm.

Edgewise Winding of Metal Strip

By HERBERT A. FREEMAN

METAL washers and gaskets of large size and various shapes, such as are ordinarily cut out by hand or punched out in a press from sheet stock, can often be produced at a considerable saving in stock and tool equipment costs by winding strip stock edgewise into a coil of the shape desired, and then sawing through the coil lengthwise. The ends of each convolution can then be joined to form a washer or gasket. Various methods are used to produce work of this kind, some of which involve the use of rather complicated machines. However, the methods described in this article are quite simple, and yet turn out work of a satisfactory quality at a good production rate.

If we place a piece of ductile material, such as wire solder, in a vise, and press it over the edge of the vise jaw to obtain a right-angle bend, it will be found that the solder assumes the shape shown at *A*, Fig. 1. It does not have the form of a true right angle, but has a pronounced hump where it passes over the corner of the vise, and in addition, springs back a little so that it is no longer parallel with the line *XX* at right angles with the part gripped between the vise jaws.

Effect of Stressed Fibers on Shape of Bend

When a piece of metal is permanently bent, the fibers farthest from the center of the cross-section are stretched beyond the yield point of the material. When the bending stress is removed, the stretched fibers, which have lost their elasticity and power to resume their former shape, are "set," just as a closed spring becomes "set" when it is overloaded. The fibers nearer the center, which have not been strained so much and still have life or enough springiness left in them to tend to straighten out again, interact on the stressed fibers in such a way as to cause the piece of solder to spring back a little upon the removal of the bending force. The fibers that are farthest from the center of the section and on the inside of the bend are subject to high compression, which results either in a bulge or wrinkle or a hump, as shown at *A*.

Bending Piece to Form Sharp Right-angle Bend

As an experiment, take another piece of wire solder, and instead of proceeding as in the previous experiment, exert a strong pull on the solder as it is being bent over the vise jaw. If this is done properly, it will be found that the solder lies smooth on the vise jaw, has a right-angle bend with a sharp corner and no spring-back.

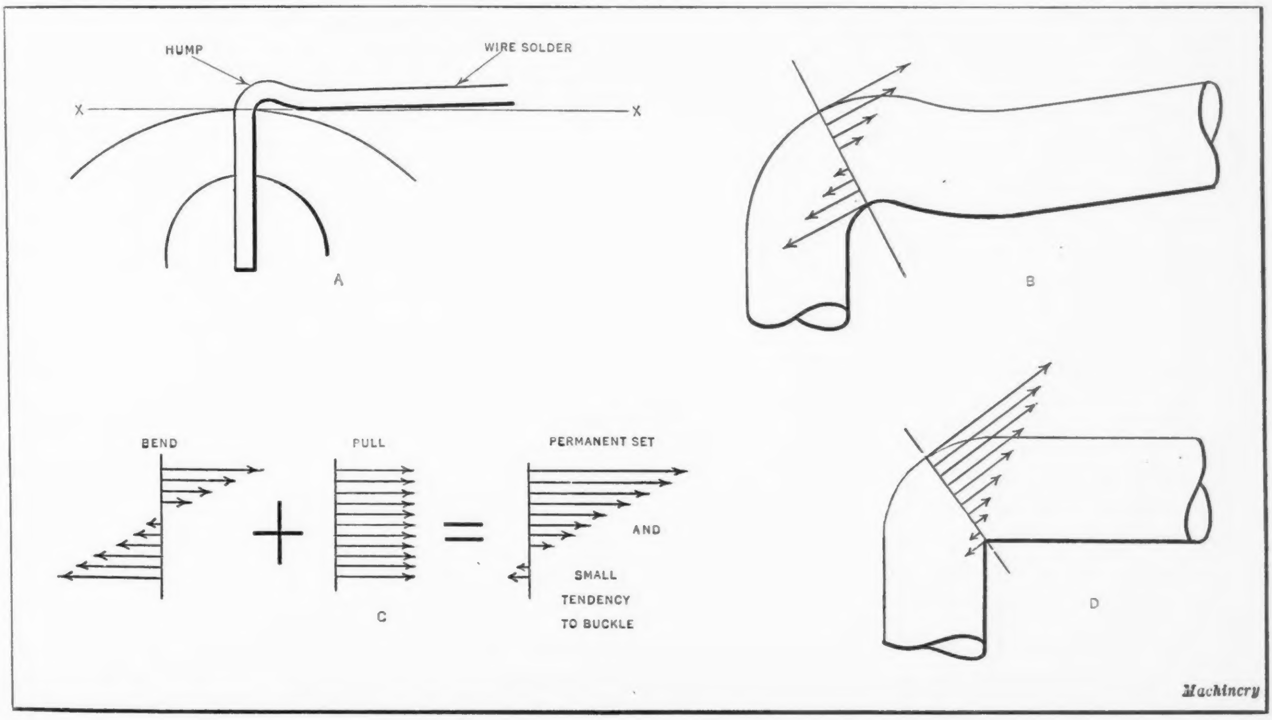


Fig. 1. Diagrams Used in Studying Stresses in Bent Stock

At *B* is indicated the distribution of the stresses when the bend at *A* is being made. The small arrows indicate the direction, and their length the magnitude, of the stresses at different sections of the bend. It will be noticed that the stresses increase until they pass the yield point of the material as we advance farther from the center of the cross-section.

Now when a pull is exerted on the piece while it is being bent, a stress is imposed on the work that is uniform throughout the section, as indicated in the center diagram marked "Pull" at *C*. The resulting stress due to the combined pull and

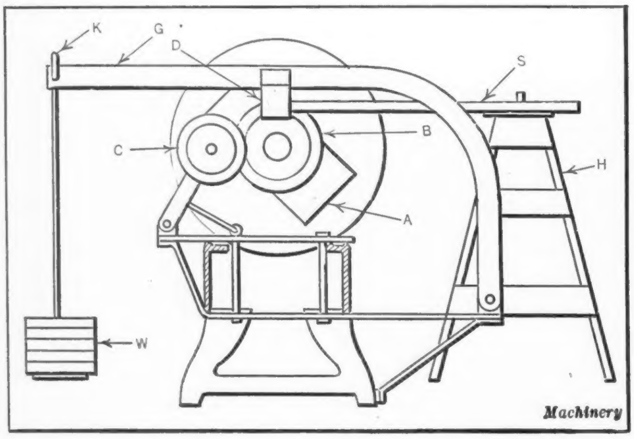


Fig. 2. Machine for Winding Strip Stock Edgewise

bend is indicated by the equation at C. Here it will be noted that the line of "no stress," or the "neutral axis," is no longer in the center of the piece, but has moved downward toward the compression side.

By increasing the pull, the neutral axis can be caused to pass entirely outside of the material and have only an imaginary existence in space. When this condition exists, there is no fiber of the piece under compression; consequently, there is no tendency for the piece to bulge, wrinkle, hump, or have a perceptible spring-back.

A right-angle bend could be obtained with less exertion if the piece were bent farther than necessary, and allowed to spring back to a right-angle position, but the tendency to buckle on the compression side would be greatly increased. The theory of the subject has been gone into somewhat in detail, as it is necessary that both the designer and operator clearly understand what takes place in the metal before a device for edgewise winding can be properly designed and adjusted.

Equipment for Winding Edgewise Spiral

The simplest spiral to wind edgewise is one of circular shape. In Fig. 2 is shown a machine designed for winding spirals of this kind. The more important parts of the device are shown in Fig. 4. A cross-section of the winding arbor and friction wheel is shown in Fig. 3.

The arbor stand A, Fig. 2, is bolted to the face-plate of a back-geared lathe. On the face of the arbor B, which is mounted on stand A, is turned a shoulder of the correct diameter for producing a washer with a finished hole of the required diameter. The height of the shoulder is made slightly less than the minimum thickness of the stock to be bent, to allow for slight variations in the thickness of the commercial material. The arbor has an outside diameter slightly less than the outside diameter of the spiral, and is back-faced smooth, so that the friction wheel C can ride against it. At D is a shoe which rides on the strip S, forcing it down on the arbor. Weights W pull the lever G down, so that the shoe bears on the work with the required amount of pressure.

To give stability, the lever G is bent, as shown, and pivoted at a low point. This lever is equipped with a shackle K to which a chain hoist may be attached. At H is a horse on which is mounted the stock reel. All surfaces that bear against the stock are polished. The axial tension adjustment of the friction wheel is effected by bolts which draw the retaining nuts up against spring washers. In the center of the machine, is a wooden mandrel which receives the turns as they pass from the friction wheel. This mandrel may be driven by a dog in the manner employed to drive work held on lathe centers. For the sake of clearness, the mandrel is not shown in the illustration.

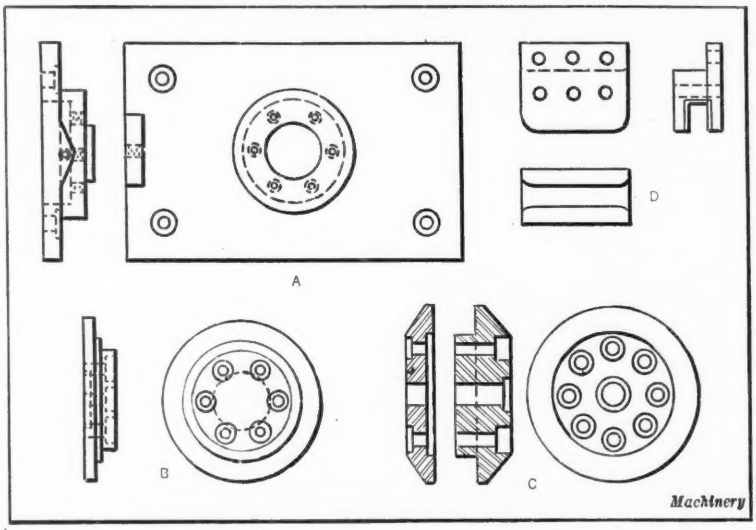


Fig. 4. Details of Parts of Winding Machine Shown in Fig. 2

The enlarged cross-section, Fig. 3, shows the friction wheel C riding over the stock and forcing it down against the arbor. To operate the winding equipment, the stock is first threaded under the friction wheel, and the shoe is then lowered into place and weighted, after which the stock is lubricated so that it will not cut, and the friction members are bolted down. The tighter the bolts are drawn, the greater will be the pull on the stock and the closer will it conform to the diameter of the arbor; also the less tendency will there be for the stock to bulge on the compression side. There is a limit, of course, to the amount of pull to which the stock should be subjected, as too great a pull will strain the outer edge of the stock to the breaking point.

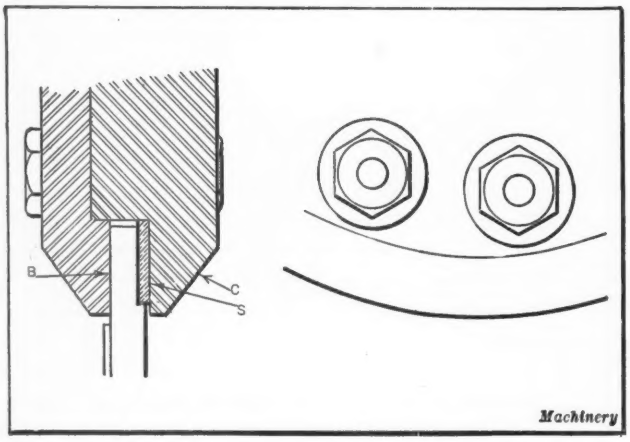


Fig. 3. Cross-section of Winding Rolls on Machine Shown in Fig. 2

Making Elliptical Washers

Elliptical washers are made in the same manner as circular washers, except that the friction wheel

must be so pivoted that it will compensate for the varying center distance at which it must operate. Circular spirals can be turned out rapidly, a speed of 100 feet of strip stock per minute being not unusual. Other shapes must be produced more slowly, owing to the fact that the levers that carry the shoes and friction wheels move up and down like pump handles, and if the speed is too great, the effects of inertia make it impossible to maintain uniform pressure. Rectangular pieces are easily made with equipment similar to that shown in Fig. 2, provided they are not more than three times as long as they are wide. For work in which the ratio between the lengths of the sides is greater, a special device, termed an "oscillator," is required, which will be described later.

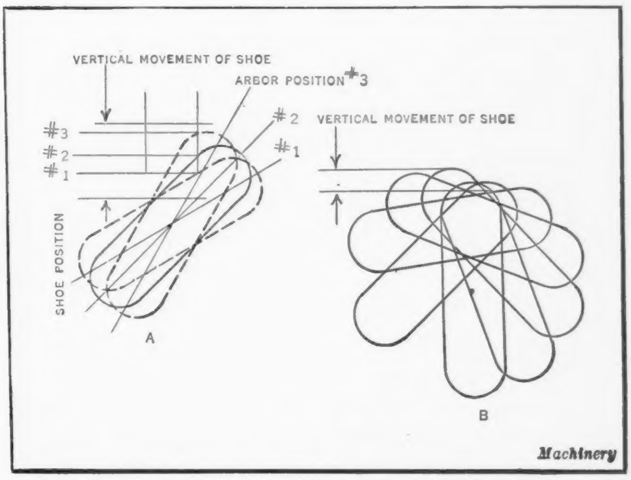


Fig. 6. Diagrams Indicating Motions in Winding Coils

"Over-bending" to Obtain Square Corners

It is sometimes advisable to use the "over-bent" principle in making rectangular coils. "Over-bending" may be accomplished in two ways: The first method, shown at *A*, Fig. 7, consists in relieving the mandrel at the ends of the bends so that the metal will be forced around a corner of more than 90 degrees. This relief should not be so deep that the metal on the flat part of the coil will be stressed beyond the elastic limit, which would, of course, result in a kink. The tread of the shoe must be of such proportions as to follow the irregular outline.

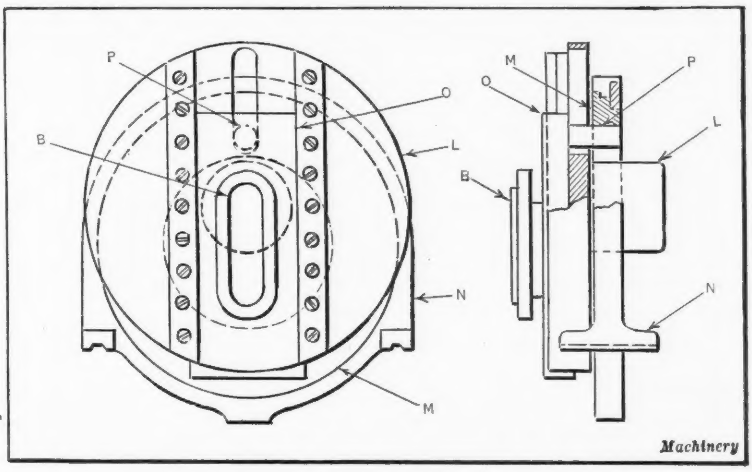


Fig. 5. Oscillator for Coil-winding Arbor

The other method referred to consists in making the arbor in two parts, as shown at *B*. Each part of the arbor is free to swivel around a stop, independently of the other part, as indicated by the dotted lines. The movement of the two halves of the arbor is limited by fixed or adjustable stops. Generally the sides of the arbor are not made parallel, but deviate from about 2 to 5 degrees. This practice is frequently used on coils having semicircular ends.

Special Equipment for Winding Rectangular Coils

The equipment shown in Fig. 2 must be modified somewhat to produce a satisfactory coil having a length greater than three times its width. The reason for this is indicated in the diagram at *A*, Fig. 6. As the coil arbor moves from position No. 1 to position No. 2, it is necessary for the shoe to ride up a very steep incline, and there is considerable likelihood of its catching and damaging the equipment. To lessen the incline up which the shoe must travel, either of two methods may be used. In one case, the fulcrum of the shoe lever is periodically moved to lessen the angle between it and the work. The other and more common method is to mount the arbor in such a way that it oscillates up and down as it rotates. A simple device for accomplishing this action is shown in Fig. 5.

Construction of Oscillator for Coil-winding Arbor

At *L*, Fig. 5, is a faceplate having a recess in which slides a block *O* which supports the arbor *B*. A pin *P* in the slide extends through a slot in the faceplate and enters a hole in the ring *M*, which, in turn, rotates in a frame *N* that is bolted to the lathe shears like a steadyrest. The ring oscillator *M* is eccentric relative to the lathe spindle by an amount equal to one-half the throw required for the arbor. Arbor *B* should be bolted to the slide in such a position that the center of the arbor will coincide with the center of the ring *M* when pin *P* is directly over and in line with the centers of the lathe spindle and ring *M*. If the mechanism is not

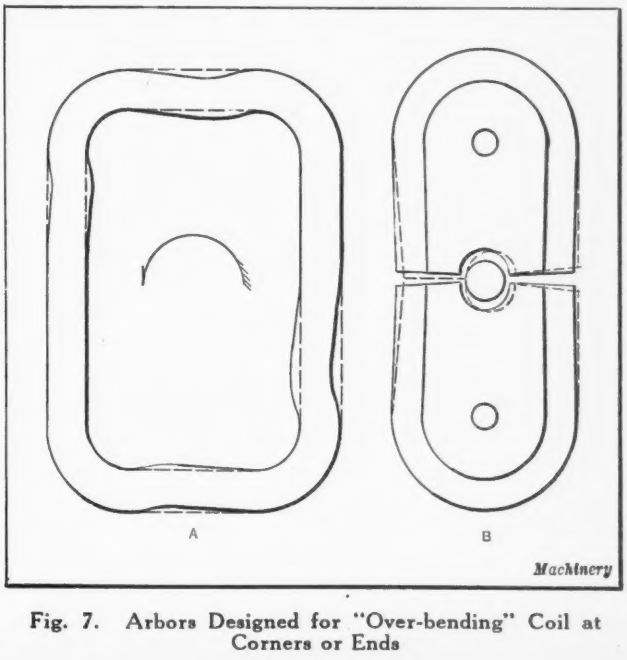


Fig. 7. Arbors Designed for "Over-bending" Coil at Corners or Ends

set up in this manner, the resulting motion as the spindle rotates from 0 to 180 degrees will differ from that during the rotation from 180 to 360 degrees.

In the unusual case of ovoidal and other shapes that are symmetrical about only one axis, this non-uniformity of position may be desirable. At *B*, Fig. 6, is shown the same coil as at *A*, but instead of being rotated with the lathe spindle axis as the center, it is mounted in an oscillating device of practically the same design as the one just described. It will be noted that the tread of the shoe is at all times nearly tangent to the outline of the coil, and that the vertical travel of the shoe per revolution of the arbor is reduced 75 per cent, which permits the use of much higher spindle speeds, and results in increased output.

When there is considerable work of various proportions and sizes to be handled, it is well to construct the oscillator frame in two parts and make provision for adjusting it vertically, so that the oscillator can be given different degrees of eccentricity relative to the lathe spindle. In winding round work, it is only necessary to adjust the oscillator so that it is concentric with the face-plate, to obtain the equivalent of the arrangement shown in Fig. 2. In Fig. 8 are shown the principal parts of the oscillator, to which the tool designer can add whatever refinements he may deem necessary or desirable.

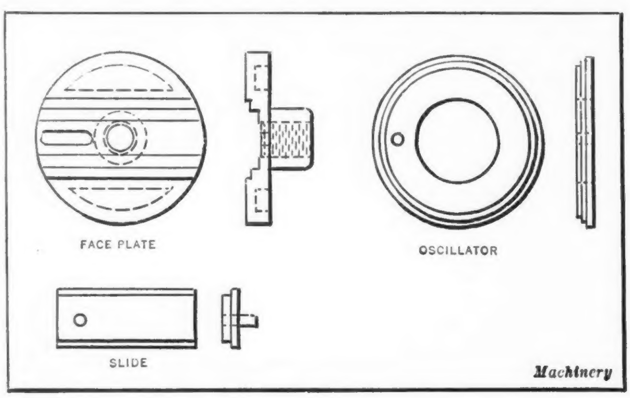


Fig. 8. Details of Winding-arbor Oscillator

An important advantage in the fundamental principle underlying the method just described is that only a fraction of a turn of the spiral is on the arbor at one time. The completed turns rest loosely on a wooden mandrel, which serves only as a support. Each turn can therefore be considered as a separate piece of work, which is not affected by any other turn. One turn of the work can be measured, and the necessary adjustments made to give the required shape, with the assurance that the work will not change its form when removed from the lathe. When a spiral is wound complete on the working arbor, it is bound to unwind or become deformed somewhat when removed.

As a rough guide to the range of work that can be handled with the winding equipment described, it may be said that soft brass, copper, and lead strip having a width of not more than twenty-five times the thickness have been handled. The radius of the bend should not be less than 1 1/2 times the width of the stock, if possible. All non-ferrous ductile materials and alloys can be worked, although some difficulty may be experienced with zinc.

* * *

The Pennsylvania Railroad is engaged in installing automatic signals and train control devices involving an expenditure of $8,000,000, which is said to be the most extensive installation of signal protection devices ever undertaken by any railroad at one time.

USE OF OAKITE IN RAILROAD SHOPS

In a paper read by C. J. Copley before the annual conference of the Oakite Products, Inc., formerly the Oakley Chemical Co., 22 Thames St., New York City, held last December, a cleaning composition particularly suitable for cleaning locomotive parts, when the engines come into the shop for overhauling and repair, was recommended. When grease and oil are to be removed from machined metal surfaces, "Dry Oakite Plater's Cleaner" has been found to work very well—1 ounce of the cleaner being used to 1 gallon of water. When grease and oil are to be removed from a painted surface without materially injuring the paint, "Oakite Plater's Cleaner," 1/2 ounce to 1 gallon of water, has been found most satisfactory.

The author stated that by using these cleaning compounds, various parts could be cleaned more rapidly than by former methods; he gave the following time for cleaning with the recommended solution: Equilibrium bars, 5 minutes; driving boxes, 3 minutes; springs, 8 minutes; frames, 1 hour 15 minutes; wheels, per pair, 30 minutes. By former methods it required from two to three times as long to do effective cleaning. Because of the rapidity with which the cleaning can be done, all the cleaning work can be done at night, so that the parts are ready in the morning for the day repairmen.

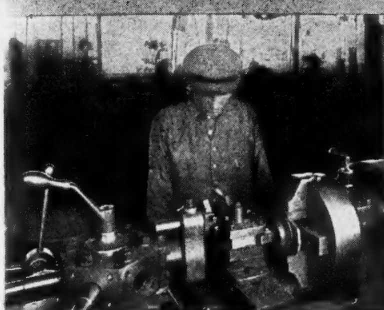
In one test, a forward truck of a locomotive was cleaned for inspection and repairs by the methods formerly used and by the "Oakite" cleaning method. It was found that by the old method 1 3/4 hours was required, while 3/4 of an hour was all that was necessary by the new method. The cost for the job for labor and material was 60 cents, whereas the cost with the hand cleaning method formerly used was 87 cents, exclusive of the cost of kerosene and cleaning waste. Furthermore, the work was cleaner with the new method.

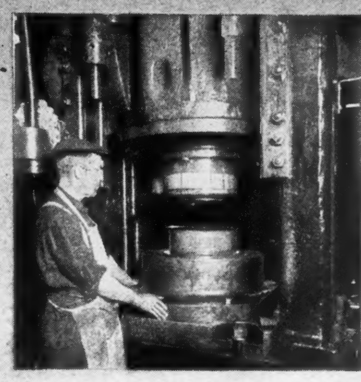
* * *

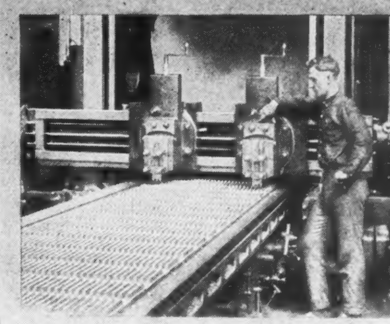
EXPERIMENTS ON PLANER TOOLS

Recent experiments undertaken to determine the proper form of planer tools, as referred to in the January 6 number of *Machinery* (London), are said to have shown that the clearance angle has no influence on the force needed to push the tool forward so long as the tool does not drag; that the force on the tool remains constant for a wide variation of keenness of cutting edge, and for thick chips, particularly, the tool edge may be rounded to 0.008 inch radius without appreciable increase in the cutting force. It is also stated that the cutting force on the tool is reduced in proportion to the increase in front-rake angle. It is shown that thick chips are removed more efficiently than thin chips, and that narrow chips are removed more efficiently than wide chips.

Letters on Practical Subjects







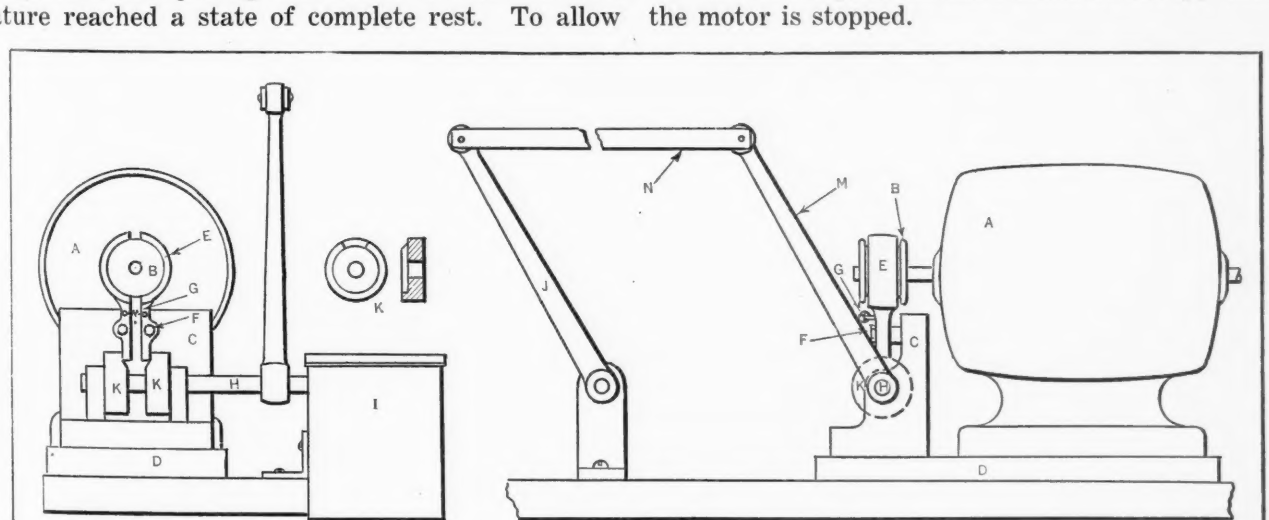
BRAKE FOR MOTOR USED IN WINDING SPRINGS

The accompanying illustration shows an attachment that made it possible to obtain frequent reversals of rotation of a high-speed motor without damaging it. The motor is used for winding springs in lengths up to 30 inches and in varying sizes of wire and diameter. The spindle consists of a piece of drill rod held in a chuck mounted on the armature shaft next to the brake-drum. The wire is unwound from the spindle, and is guided closely by hand along the drill rod. On the smaller sizes, which use very light wire, it is impossible for the operator to guide the wire accurately at all times, with the result that the spring is wound back over itself or may not be spaced equally. When this happens, the operator immediately reverses the motor to unwind the defective part, and then rewinds the spring. The operator moves along the table as the spring is wound, so that a shifter rod is required for controlling the motor at all points.

The motor is a 1/2-horsepower, 220-volt, single-phase ball-bearing type, operating at a speed of 3500 revolutions per minute, and is equipped with a two-way textile type oil switch. The momentum of the armature is so high that considerable time elapsed after opening the switch before the armature reached a state of complete rest. To allow the motor to reach the maximum speed and then reverse it quickly, resulted in rapid overheating of the motor, so that it was necessary to attach some form of brake that would quickly reduce the speed.

Referring to the illustration, the motor *A* carries on its shaft the brake-drum *B*, which is similar to an ordinary flanged pulley. The plate *D* on which the motor is mounted carries an angle-bracket *C* which supports the brake-shoes *E*. The brake-shoes pivot on the studs *F*, and are drawn together by the spring *G*. The inner surfaces of the brake-shoes are lined with leather which serves as a friction material for the brake-drum. The shaft *H*, which is a continuation of the shaft that operates the contacts in switch *I*, passes through two ears on the angle *C*, and carries the lever *M*, which actuates the shaft *H*.

Two cams *K* are pinned to shaft *H* between the ears on angle-bracket *C*. These cams operate the brake-shoes *E*. Lever *J* is fastened by a pivot to the bench, and is connected to the lever *M* by a shifter rod *N*. In the view at the left-hand side of the illustration, the projecting lower ends of the brake-shoes are shown resting on the low points of the cams, the spring drawing the brake-shoes together so that they exert a braking effect on drum *B*. This is the position these members occupy when the motor is stopped.



Motor Equipped with Brake to Permit Rapid Reversal of Shaft

In the view at the right-hand side of the illustration, the shifter lever is shown moved to one side, so that the switch contacts are closed, and the pressure of brake-shoes E on the drum is released by the action of cams K, so that the motor is free to operate. The design of the cams is such that they come into action slightly before the electrical contact is made in the switch. The tension of the spring is sufficient to almost stop the motor in the time required to move the shifter to the opposite side of its throw. With this braking arrangement, very little increase in temperature in the motor is perceptible under continuous operation and repeated reversals.

Philadelphia, Pa. R. H. KASPER

PIERCING HEAVY STOCK

It is usually the practice to drill holes in sheet stock when the diameter of the hole is less than the thickness of the stock. If certain departures from the ordinary construction of press tools are made, it is not difficult to pierce, in moderately hard stock, a hole having a diameter equal to three-fourths the thickness of the material. These modifications of ordinary practice are increase in clearance between punch and die; special pointing or grinding of the punch; and the use of special punch steels.

The first of these methods—increase in clearance between the punch and die—has the apparent disadvantage of producing a cone-shaped hole. However, this disadvantage is more apparent than real, unless the hole is to be used as a bearing, when it is usually necessary to ream out even a drilled hole. A little care in deciding which side the stock should be pierced from will ordinarily avoid any objections to this method. The clearance between the punch and die should be twice that ordinarily used. The set of curves, Fig. 2, show the clearance between punch and die required for heavy piercing. The difference in diameter is twice the clearance.

The second variation from regular practice—pointing the punch—is not new. It is common practice to give shear to punches in order to reduce the pressure required for piercing the stock. In this case, the shape of the nose of the punch has two other important functions. It prevents the punch from slipping sidewise, and by bulging the stock into the hole in the die, prevents the stock from moving. The best method is to grind the point of the punch into a three- or four-sided pyramid, as shown in Fig. 1. This is easily done by hand on an ordinary bench grinder, and produces a sharp point

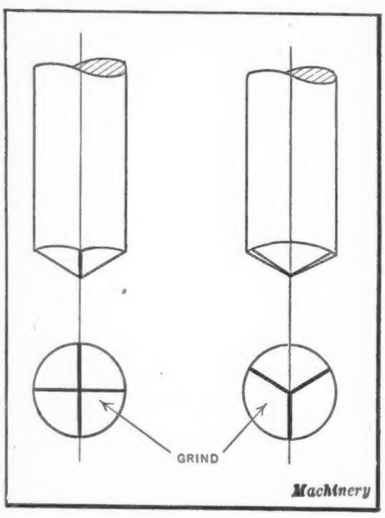


Fig. 1. Punches Ground for Punching Deep Holes

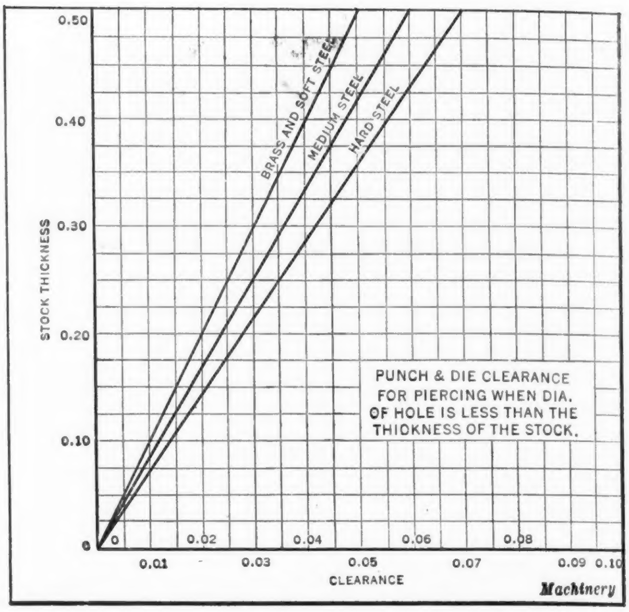


Fig. 2. Curves Showing Clearance for Punches

which not only prevents slipping but also tends to center the punch in the hole.

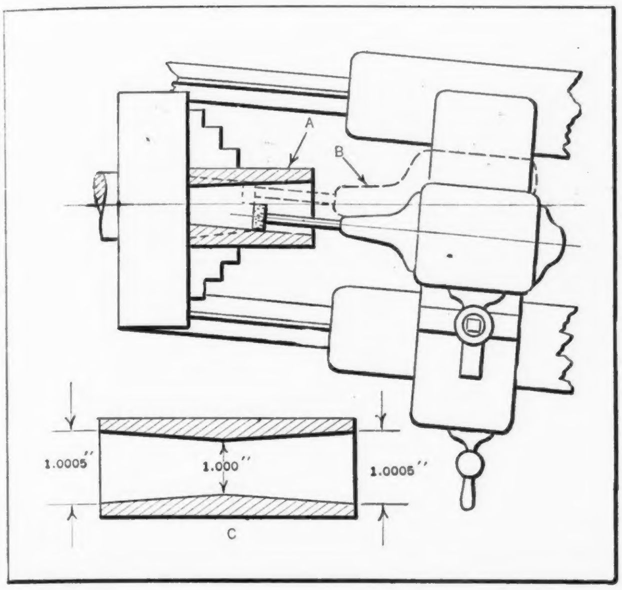
In some cases, failure of punches in piercing heavy or hard stock is due to upsetting or buckling of the punch, especially when the punches are hardened only at the end. Most good tool steel makers now include a special punch steel in their lines. As the most prominent characteristic of these steels is their strength, punches made from them are very stiff and sturdy, and withstand the impact of heavy, fast piercing very well. Instructions for hardening them should be obtained from the steel maker. A certain amount of experimenting in the application of the foregoing methods is required to get their full benefit, but the saving that is made possible by substituting the punch press for the drill press is so marked as to make it well worth while.

Riverside, Ill. F. MARTINDELL

GRINDING A HOLE STRAIGHT WITHIN CLOSE LIMITS

Every toolmaker has experienced difficulty in grinding holes straight or parallel within close limits when the hole is 3 or 4 inches long and 1 1/4 inches in diameter or less. The usual method employed in our shops for such work is to bolt a "Dumore," or similar electric grinder to the toolpost of a lathe and proceed in the conventional manner. Unfortunately, however, there is always a slight taper in a hole that has been ground in this manner.

We found that the error was greater when the work was ground on certain lathes, and in all cases was due to the fact that the headstocks were out of alignment with the ways of the lathe. This condition is shown greatly exaggerated in the accompanying illustration. It is obvious that when the grinder is advanced along the ways, which are at an angle with the center line of the lathe spindle, as indicated, the work will be ground tapering, as shown by the sectional view at A. If, however, the following method of grinding is employed, the error can be cut in half.



Method of Reducing Error in Grinding Straight Hole

First, the outer end of the hole is ground until a plug gage can be inserted half way through the hole. Next the grinder is moved over to the position shown by the dotted lines at *B*, and the inner end of the hole ground to the required size with the grinding wheel in contact with the work at the back side of the hole. This grinding operation is continued until the plug gage can be passed entirely through the hole. A somewhat exaggerated view of a piece of work ground in this manner is shown at *C*. In this case, the required diameter of 1.000 inch is obtained at the center of the hole, while the hole is 0.0005 inch large at each end. This variation, however, is only one-half what it would have been had the hole been ground in the usual manner without moving the grinder over, as explained.

London, England ROBERT JULIAN

CLEARANCE BETWEEN BLANKING PUNCHES AND DIES

Referring to the information relating to clearance between blanking punches and dies in December MACHINERY, page 296, the writer would like to point out that the value obtained from the formulas there mentioned is the clearance on one side only of a punch and die, and is only one-half of the total clearance or difference between the punch diameter and the die diameter. The total clearance would be obtained by dividing by the figures 10, 8, and 7, respectively, for different kinds of stock, instead of by 20, 16, and 14. Hence, the total clearance between the punch and die, or the difference between the punch diameter and the die diameter, equals:

For soft steel and brass, thickness of stock divided by 10;

For medium rolled steel, thickness of stock divided by 8;

For hard rolled steel, thickness of stock divided by 7.

By writing the formulas in this way, all possibility of misunderstanding or confusion will be avoided.

Hamilton, Ont., Canada GEORGE MEINHARDT

FELT CUTTING ON A PUNCH PRESS

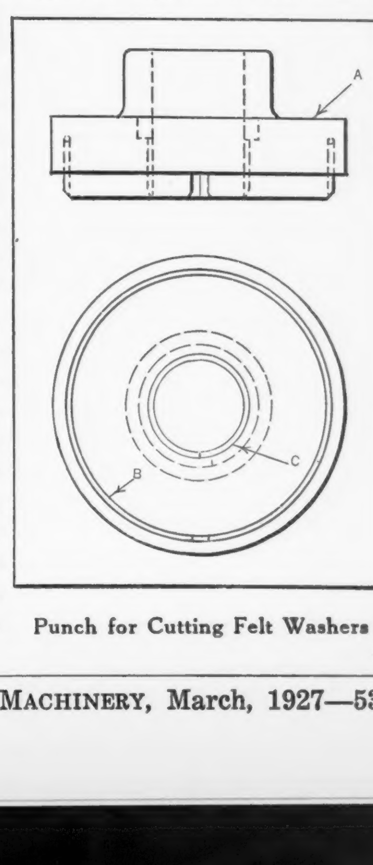
The article "Cutting Felt Washers on a Punch Press," on page 210 of November MACHINERY, brings to mind a similar job for which a different type of die from the one described was employed. Our shop had submitted a bid on a certain assembly job, believing that all parts would be furnished in a finished condition. On receiving the contract, it was found that the felt for the oil-retaining washers was supplied in pad form and that according to the contract, it would be necessary to cut out the washers—a job for which our shop had no adequate equipment.

There seemed to be no alternative but to cut the washers by hand from the 1/2-inch thick felt to a diameter of 4 inches, with a central hole 1 1/2 inches in diameter. On corresponding with diemakers, it was found that a suitable die for cutting the washers could not be obtained within six weeks. The cost of having the washers formed by some outside shop was also prohibitive. After considering the problem carefully, it was decided that the washers could be cut out on a light punch press equipped with a sort of clicker die.

Accordingly, the top and bottom heads of the press were fitted with hard maple facings, so that with the ram in its lowest position, there was a clearance of 2 1/2 inches. The die shown in the illustration was improvised from a 2-inch thick disk *A* formed from a 5-inch bar of round steel, and two experimental cutter blades *B* and *C* made from saw steel 5/64 inch thick. The saw steel cutters were made to fit into grooves in the face of the disk. The inner cutter for the 1 1/2-inch hole was made to bottom against a shoulder in the clearance hole, which extended around the disk, while the outer or 4-inch cutter was made to be held in place with blind set-screws.

Through an error, the slot in the disk was cut 1/8 inch too deep, so that when the cutter was fitted in place, it projected only 3/8 inch instead of 1/2 inch, the thickness of the felt pad. It was found that this was an advantage, as the compression of the felt within the die assisted in producing a cleaner cut.

After the die had been in use for a few hours, a small piece broke away from one end of the large cutter, and as the washers were urgently needed, the broken end was ground smooth, leaving a gap between the ends of the cutter of about 1/4 inch. This gap also proved advantageous as the washers, being cut all around except for the 1/4-inch tag, were held in pad formation. The washers could be more readily han-



Punch for Cutting Felt Washers

dled in this pad form than as individual pieces, as the assemblers could, in one snip of a pair of tin shears, cut off the washers as they were required.

The die, as described, remained in service until over 5000 washers had been produced, and the maple facings on the punch press withstood their hard usage satisfactorily. An ordinary piece of wrapping twine, soaked in shellac, was forced into the groove of the die ahead of the larger cutter, and served as a resistant pad for the knife, distributing the stress uniformly around the groove and yet cushioning the thin metal blade sufficiently to prevent it from being broken under the jar or shock of the press strokes.

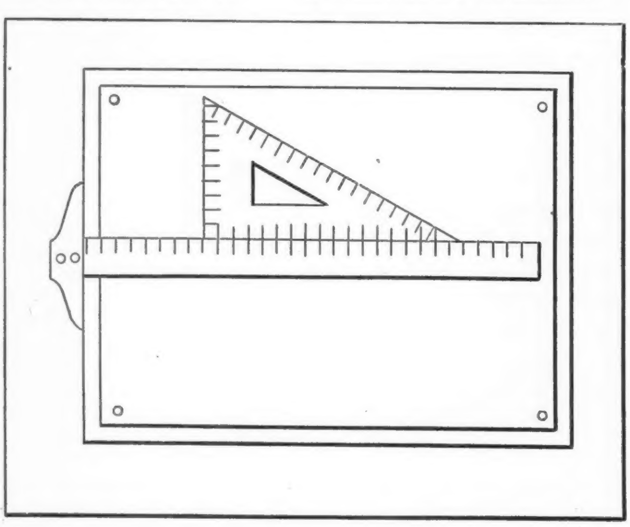
Savannah, Ga. ELTON STERRETT

UNIFORM SPACING FOR DIMENSION LINES

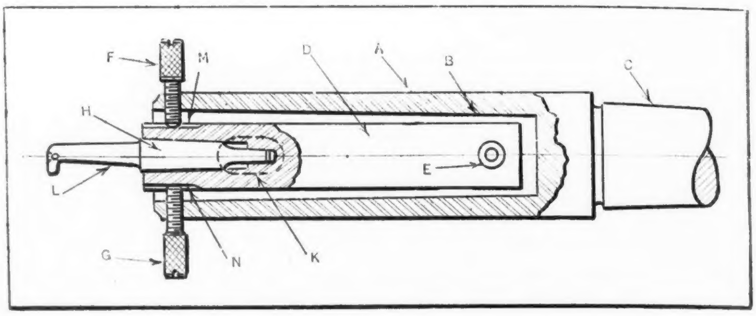
In November MACHINERY, page 215, was described a good method for obtaining uniform spacing of dimension lines. Another means of accomplishing the same object is to employ a triangle and T-square, as shown in the accompanying illustration, having graduations of 1/4 inch. The graduations on the T-square should be numbered consecutively, beginning at the left-hand or head end of the straightedge. The graduations on the triangle should also be numbered.

As an example of the use of the graduated T-square and triangle, let it be assumed that we are placing vertical dimension lines on a drawing that requires several lines. Let us, for instance, first carry the over-all length line up to the No. 20 graduation on the triangle; then for the next dimension limit line we drop down to No. 18, for the next to No. 16, etc. Then when we draw the dimension lines on the other side of the drawing, we can carry the first line up to the lowest number used on the other side of the drawing, and as we move outward toward the overall length line, increase the length of each line two spaces. By employing the graduated triangle in this manner, the limit lines for each dimension will be uniform, and the drawing will have a neater appearance.

Philadelphia, Pa. CLARENCE D. HAEDRICH



T-square and Triangle for Spacing Dimension Lines



Adjustable Boring Tool for Lathe Tailstock

ADJUSTABLE BORING TOOLS FOR LATHE TAILSTOCK

Nearly every toolmaker and a great many machinists have their own adjustable boring tools for various purposes. I have seen a great many of these arranged to be set by means of an eccentric, a small worm and gear, and various kinds of set-screw adjustments. Recently, however, I saw one very different from any of these which rather appealed to me as being simple and easily adjusted. It also possesses features which allow a varied assortment of boring tools to be quickly inserted or removed. The shank *A* is bored out at *B* and reamed with a No. 10 Brown & Sharpe taper reamer, and the shank *C* is made to fit the tailstock spindle. Inside the taper hole is the cylindrical tool-holder *D*, pivoted far back in the holder at *E*. At the extreme front end there are two pointed screws at *F* and *G*, which enter V-shaped grooves at *M* and *N* and support the tool-holder *D*. The screws are knurled for finger adjustment and also slotted on the ends so that a screwdriver can be used. The hole in the end of the swivel member is reamed for a No. 2 B. & S. taper at *H*, and slotted in the usual way to permit quick removal of the tool and to facilitate driving. The body of the main holder *A* is also slotted, as shown by the dotted lines at *K*. The boring tools are made in a number of sizes, one of which is shown at *L*. These are of carbon steel, formed to shape, centered, and hardened and ground to fit the taper.

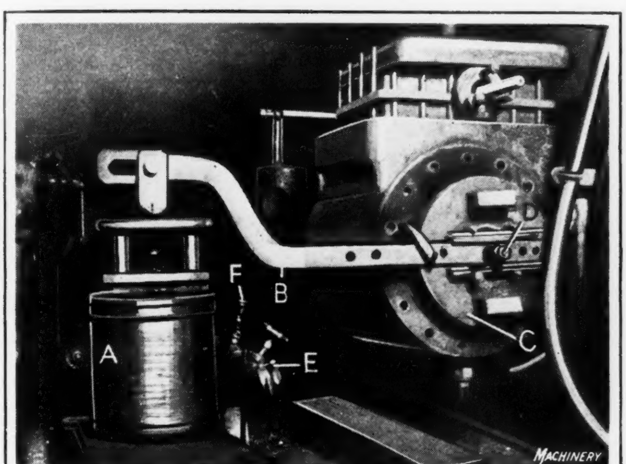
Detroit, Mich. ALBERT A. DOWD

PORTABLE CYLINDER HEAD GRINDING MACHINE

The grinding-in of the cylinder head of a large locomotive, by hand, is a laborious task which often requires from two to three days time. With the power-operated grinding machine shown in the accompanying illustration, the time is reduced to from two to three hours. The machine consists primarily of the steam end *A* of a 9 1/2-inch Westinghouse air pump, mounted on a heavily constructed wagon or truck made from heavy channel iron, and a lever *B* for transmitting motion from the piston of the cylinder *A* to the head *C* to be ground-in. It is essential that the truck be of heavy construction in order to insure a firm support for the cylinder so that it will maintain its position during the grinding operation. The raising and lowering action of the connecting-rod would, of course, move a lightly constructed truck out of position.

The cylinder A is secured to a cast-iron bracket which is bolted to the channel iron base. A hole 12 inches in diameter is cut in the channel iron through which the valves of the cylinder project. The valves are therefore accessible in case adjustments or repairs are required. The rod D which holds the cylinder head in place extends through the cylinder and a cross-piece at the rear of the cylinder. A spring and nut at the end of the rod serve to hold the cylinder head against the cylinder with the proper amount of tension. Crushed steel and lubricating oil are placed on the surfaces to be ground-in.

The machine can be operated either by an air or steam line connected to the hose coupling at E. A globe valve located just back of the hose coupling is employed to regulate the speed of the machine. The cylinder is lubricated by an oil-cup F placed in the inlet pipe. The particular machine shown in the illustration has been in use for three years, and



Grinding-in Locomotive Cylinder Head

the replacing of a broken valve rod has been the only repair work required.

Chattanooga, Tenn. H. H. HENSON

FINDING RADIUS OF GAGE

The writer was recently confronted with the problem of making a plug gage that would make contact with three points, as shown in view A of the accompanying illustration. The radius of the plug was required to be accurate within three decimal places. The problem was first solved by trigonometry and afterward by algebra. The algebraic solution is given in the following, and should be of interest to toolmakers, as it can be employed when no table of trigonometrical functions is available. The method should also be useful in cases where the table of trigonometrical functions is not carried out to the number of decimal places necessary to give the required accuracy.

Referring to view B, we have given the dimension 1.75, the perpendicular CD, and the dimension 0.375. The problem is to find the radius R. After drawing the construction lines

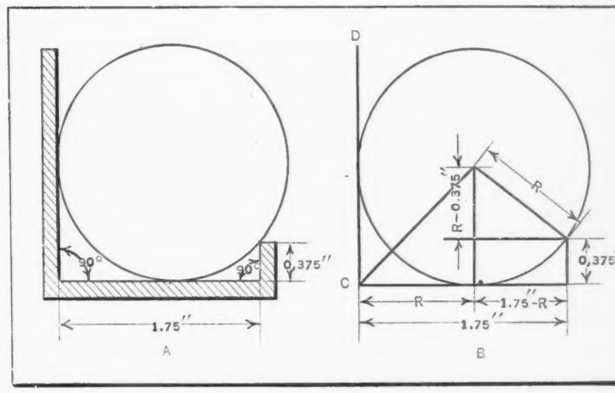


Diagram Used in Finding Radius of Gage

as shown, it is obvious that

$$R^2 = (1.75 - R)^2 + (R - 0.375)^2$$

Squaring, combining, and transposing terms, we have:

$$-4.25R + 2R^2 + 3.203125 = R^2$$

or

$$-4.25R + R^2 + 3.203125 = 0$$

Solving this quadratic equation, we have

$$R = \frac{-4.25 + \sqrt{4.25^2 - 4 \times 1 \times 3.203125}}{2 \times 1} =$$

0.97904

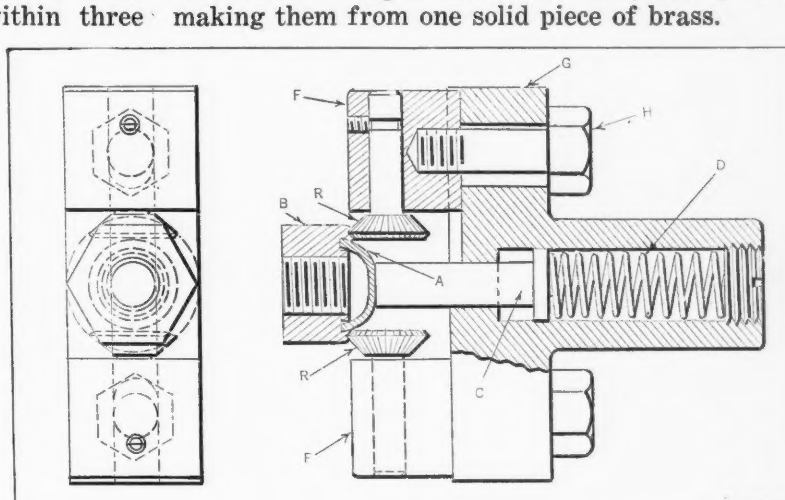
Therefore, the diameter of the gage equals 0.97904×2, or 1.95808 inches.

Other methods of solving this problem are given on pages 91 and 92 of MACHINERY'S "Draftsman's Mathematical Manual."

Philadelphia, Pa. CHARLES KUGLER

TOOL FOR ASSEMBLING NUT AND CAP

The assembling tool shown in the accompanying illustration is employed to roll or "stake in" metal around the groove cut in nut B in order to fasten the drawn brass cap A securely in place. Caps A are blanked and drawn in one operation in the plant, and the standard wrought-iron nuts are purchased from a dealer. The assembled nut and cap is nickel-plated. Six of these finished nuts are used to hold together the two main parts of a water meter casing. This method of producing the nuts was found cheaper and more satisfactory than making them from one solid piece of brass.



Tool for Rolling in Metal Around Cap Groove

The nut B is first chucked in the machine, and the groove cut in its face with a special hollow mill. The machine is then stopped and the cap A put in place, being firmly seated in the groove by tapping with a soft face hammer. The machine spindle is then started, and the tool shown in the illustration brought into operation. The spring-actuated pin C, which normally projects beyond the rollers R, comes in contact with the work first, and holds the cap in place through the force exerted by the spring D.

Rollers R, coming in contact with the face of the nut at a point just outside the groove containing the cap, roll with the nut and force the metal into the groove, closing it around the cap and securely fastening the cap in place. The rollers are nicked on their peripheries to insure a rolling action while they are in contact with the work. The nicked rolling edge is V-shaped, the included angle formed by the sides being 120 degrees. As the tool is used for nuts of various sizes, it was necessary to provide means for adjusting the position of the roll-holders F. These holders are attached to the body G of the tool by means of a tongue and groove and clamping bolts H which pass through slots in the holder. The shank of the tool is, of course, machined to fit the hole in the lathe turret.

New York City B. J. STERN

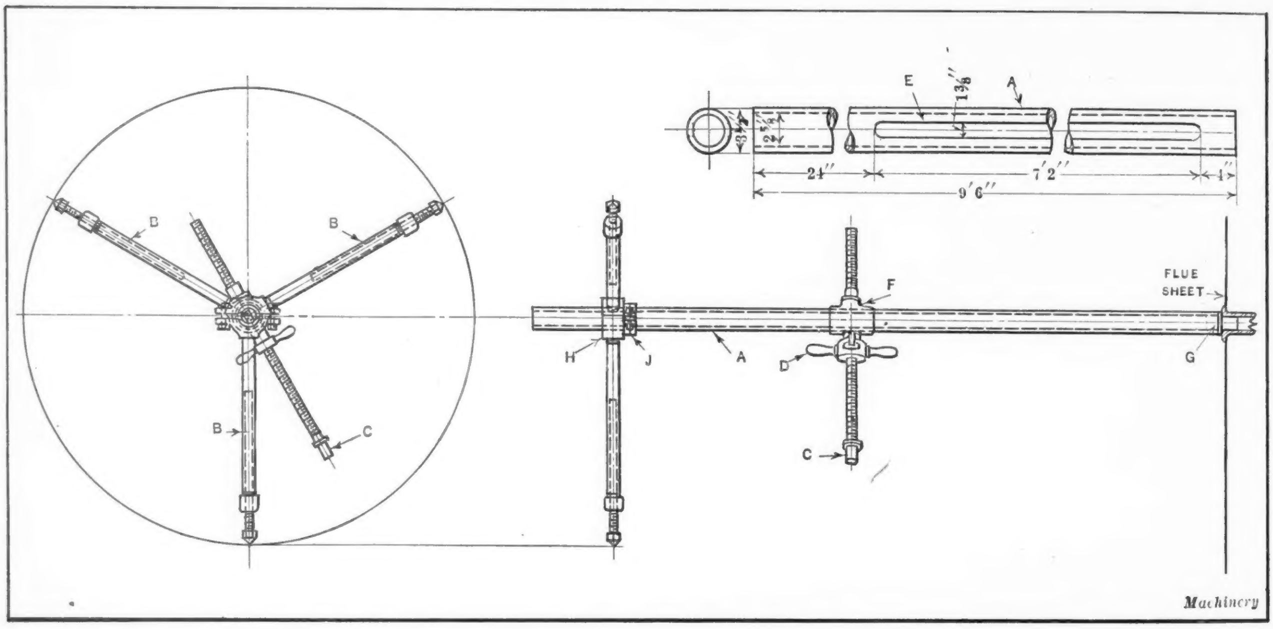
DRILLING CYLINDER SADDLE BOLT HOLES

An adjustable support that will provide a backing for the air motor opposite any cylinder saddle bolt hole has proved to be a great time-saver in the Huntington shops of the Chesapeake & Ohio Railway Co. This support, which is shown in the accompanying illustration, consists of a bar A which rests in the flue hole at the rear end, and is held at the other end by a spider having three arms B with pointed adjusting screws that are tightened against the ring at the front end of the smokebox. End C of the feed-screw is placed against the air motor, and the feeding movement is obtained by turning the hand-operated feed-nut D.

The feed-screw is 1 1/4 inches in diameter, and has seven threads per inch. This feed-screw passes through a slot E cut in bar A (see detail view). As this slot is 7 feet 2 inches long, it is possible to slide sleeve F and the feed-screw to any desired position along bar A. Bar A can also be turned in its mounting to vary the radial position of the feed-screw so as to suit the location of the hole to be drilled. Plug G has a driving fit in the end of the steel tube A, and the extension of this plug fits loosely into a flue hole. The front end of the tube or bar A turns in bearing H, and the bar is prevented from sliding forward by a clamp J.

Huntington, W. Va. E. A. MURRAY

* * *



Adjustable Support that Provides Backing for Air Motor while Drilling Bolt Holes in Cylinder Saddle

ELECTRIC MOTOR STANDARDIZATION

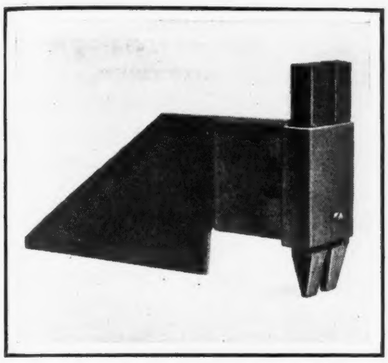
In connection with the annual meeting of the American Society of Mechanical Engineers, a conference was held at the Engineering Societies Building, 29 W. 39th St., New York City, under the auspices of the American Engineering Standards Committee, to which were invited all organizations interested in the standardization of motor dimensions. The object of the conference was to determine whether work on this standardization project should be undertaken.

Representatives of the machine tool industry, the railroads, and numerous other industrial groups indicated the desirability of this kind of standardization, and the conference voted that a committee be organized to undertake the standardization work. Representatives of the electrical companies present emphasized the difficulty of such standardization, but in general, it was believed that a reasonable amount of standardization would not be impossible. The proposed standardization relates merely to the location of bolt holes and sizes of bolts for motors of the same size, and to the motor shafts and their location above the base line. If these dimensions were standardized, it would be possible to interchange motors of different manufacture, which would be very desirable in the machine shop field.

Shop and Drafting-room Kinks

HOLDER FOR METAL STAMPS

A stamp-holder like the one shown in the illustration can be used to advantage for stamping work with double figures, using single-figure stamps. The holder shown was recently made up for use in a small shop. A similar holder can be made in a short time by bending a piece of sheet steel to enclose the stamps and fastening the two ends with rivets. By extending one end and cutting it diagonally, as shown, a convenient handle for gripping the holder is provided.



Sheet-metal Holder for Metal Stamps

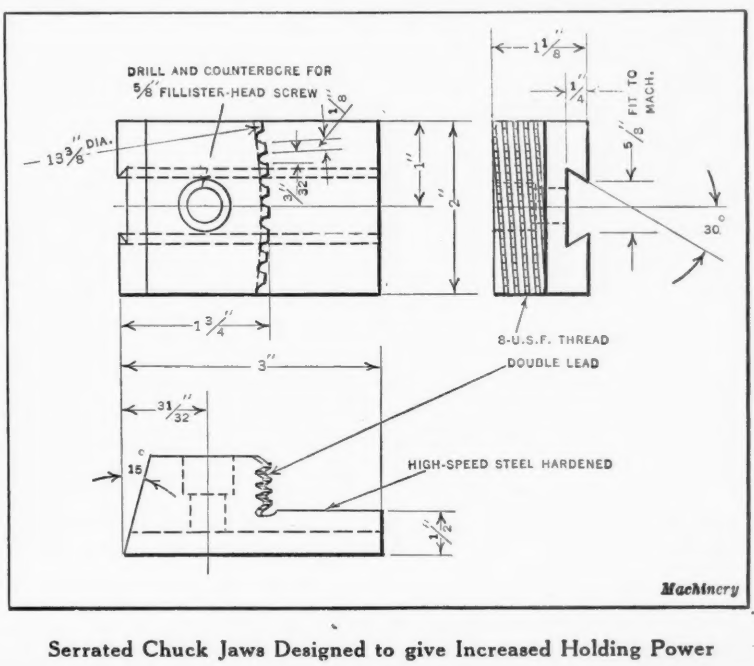
Rosemount, Montreal, Canada — H. MOORE

CHUCK JAWS DESIGNED FOR GREATER HOLDING POWER

Difficulty is often experienced in holding rough castings in a chuck while heavy cuts are being taken. It is possible to improve the holding power considerably by having serrations of the proper type in the jaws. The accompanying illustration shows a method of serrating jaws that results in increasing the holding power. The serrations are made so that the protruding edges are of a chisel shape and have a slight lead similar to a screw thread. These serrations can be made by setting up the jaws in the chuck, setting the machine to cut threads of suitable pitch, and cutting the serrations in the jaws with a threading tool.

The advantage of the spiral serration is that if there is a tendency for the work to slip, the serrations, which are slightly buried in the casting, will act in the same manner as a screw and have a tendency to draw the work against the face of the chuck. The cost of this type of serration is no greater than the ordinary type.

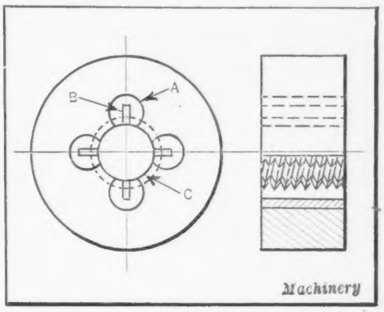
JOSEPH LANNEN
Detroit, Mich.



Serrated Chuck Jaws Designed to give Increased Holding Power

PRODUCING THE THREAD IN A DIE

As an employe of a large brass company, I conceived the idea of producing threading dies by inserting four pins in the chip holes of the die blank, then boring the center hole, and using a standard tap to cut the threads in the die. This method does away with the counterboring operation after the die is threaded. In the accompanying illustration, is shown a die with the four pins *A* in place as they appear after the threading operation has been completed. Before driving the pins into the die blank, a slot *B* is cut in each pin with a small hacksaw. The saw slots serve to break up the chips and prevent them from becoming caught under the lands of the tap. This method has been found practical for dies up to 1/2 inch in diameter. After the die has been threaded, the pins are driven out, leaving clean cut threading lands *C* in the die.



Plan and Half-section Views of Threading Die

Cleveland, Ohio — JOSEPH SLAVIN

TOOL FOR STRIPPING INSULATION FROM WIRE

Old side cutters, with the edges ground so that they form a vee when closed, make an excellent tool for stripping insulation from wire. The wire is placed in the vee formed by the cutting edges, and the tool is then pulled toward the end of the wire. This method of removing the insulation is much more satisfactory than employing a knife in the usual manner.

R. M. THOMAS
Denver, Col.

* * *

The United States Civil Service Commission, Washington, D. C., has published a pamphlet entitled "Opportunities for Engineers in the United States Civil Service," including a table giving salaries of government engineers.

Questions and Answers

DRILLING A VERY SMALL HOLE IN GLASS

E. F. P.—Can any of MACHINERY'S readers tell me how to drill or form in a piece of glass a hole 0.0002 or 0.0003 inch in diameter?

A.—Evidently it would be necessary to form this hole by the same general method employed in forming the holes in diamond dies, such as are used for drawing very small sizes of wire. According to an article on "Making Diamond Wire-drawing Dies," published in November, 1919, MACHINERY (page 264), such dies are made in sizes as small as 0.0004 inch. Is it practicable, by using a steel lap and diamond dust, or by any other method, to drill or lap in glass, a hole as small as 0.0002 inch? This question is submitted to any of MACHINERY'S readers who may have had experience with this or similar work.

EMPLOYER'S RESPONSIBILITY FOR DEFECTIVE MACHINERY

S. T. T.—What is the liability of an employer when an employe is injured by defective machinery, and under what conditions is an injured workman entitled to a judgment for damages?

Answered by Leo T. Parker, Attorney at Law

A.—Legally, an employer is expected to keep the welfare of his employes in mind at all times. Therefore, an employer should inspect or have inspected the machinery, material, and other appliances that may be dangerous to the life or health of the employes. Moreover, inspection for the purpose of locating defects should not be restricted to exterior appearances, because if the equipment is actually defective, and the defects can be discovered by reasonable and careful inspection, the employer is liable in case an employe is injured as the result of an undiscovered defect.

It has been held by the Courts on numerous occasions that an employer is not an insurer of the safety of his employes, but that he owes them the duty of providing reasonably safe machinery, and that he must exercise ordinary care to discover defects in appliances that are operated by the employes. However, if an employer furnishes tools and machinery that are apparently safe, and a workman is injured as a result of a defect that ordinary close inspection fails to disclose, the employer may not be liable. This is true, because when an employer is reasonably diligent in safeguarding his employes against injury, he is not liable. The fact that unguarded machinery effects the injury strengthens the suit of an employe to recover damages, because the Court may hold that the employer is negligent in not providing reasonably safe equipment.

In a recent case where an engineer was injured by a piece of a flywheel, which flew to pieces because the wheel was of insufficient size and strength to withstand the centrifugal force, the Court held that the employer was not responsible, because the defect was undiscoverable by the reasonably careful and frequent inspection tours of competent men. In this case, it was shown, to the satisfaction of the Court, that the employer paid competent mechanics to inspect the factory and its machinery at frequent intervals, thereby making it evident that the employer was exercising every precaution for the safety of the workman.

The period of time between the required regular inspections of equipment depends considerably on the character of the mechanism. For instance, where it was disclosed that a safety brake appliance was inspected at intervals of two weeks, the Court held that the inspections were not as frequent as was necessary, in view of the extraordinary danger attending the operation of the machinery to which the brake was attached. On the other hand, where an employer was careful to inspect another kind of machine every thirty days, the Court held that the inspections were often enough to establish carefulness on the part of the employer.

Furthermore, it is always the legal duty of an employer to warn his employes of any unusual or unexpected danger to which they may be subjected, particularly where the danger is known to the employer and unknown to the workmen. This is especially true if an employer sends a workman to operate machinery in which there is a hidden danger of which the employer knows or ought to know, and of which the employe knows nothing. It does not matter whether this danger may result from an unexpected movement of the machine or not. The employer may know that the workman is likely to attempt to operate the machine in a manner that would be not dangerous on similar machines, but that is dangerous on this particular one. An employer cannot be relieved of liability under the circumstances simply because he proves that the injured man did not request to be shown how to operate the machine.

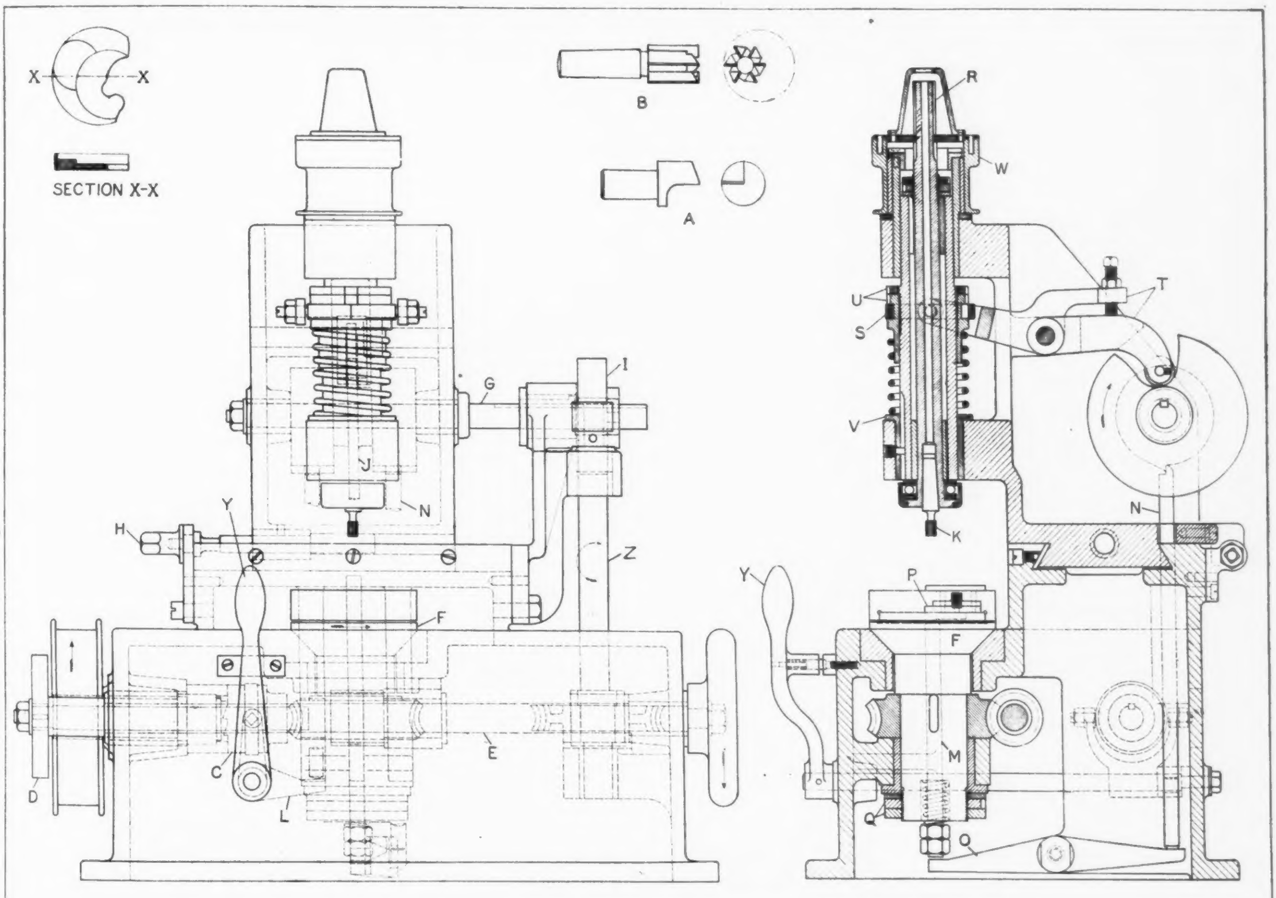
Another common source of liability is where machinery is defective and an employe complains to his employer of an unsafe machine. If the employer gives assurance that the danger will be remedied, and fails to have the matter attended to, the employer may be liable for injuries sustained by the workman. The period that elapses between the time of notification and the injury is important in determining whether or not the employer is responsible. If the accident occurs before the employer has had a reasonable time—depending upon the circumstances—to repair the apparatus, then he may not be held liable. However, the employer should not delay in having repairs made after receiving the information; otherwise he may have difficulty in avoiding liability if accidents occur.

Generally, if an employe continues to work on a defective machine that he knows is dangerous, the responsibility rests upon him, because the Courts assume that a man who is ordinarily careful will not subject himself to such risks.

Semi-automatic Vertical Milling Machine

By HOWARD M. GROFF

THE refinement of production methods is constantly bringing to light old and tried principles and presenting them in new and interesting applications, such as those incorporated in the machine described in this article. The part milled in this machine is shown in the upper left-hand corner of the accompanying illustration. This part is the foundation or base of a mechanism that contains a train of gears driven by a spring motor barrel. In order to insure rigidity, the gear base is made as heavy as possible, with recesses cut in the solid metal to provide space for the train of gears.



Automatic Machine for Milling Recesses in Base for Gear Train

The method first employed in machining the gear bases consisted of cutting the recesses, one at a time, in a series of small bench lathes fitted with special chucks and compound slides that held the cutting tools. On these lathes, the cutting tool was fed inward by a longitudinal slide to a stop set to give the required depth, and then traversed upward by the cross-slide to a stop that determined the diameter of the recess.

The finish obtained by this method was good and the accuracy satisfactory, but keener competition made it necessary to devise a quicker and cheaper method. To meet this demand, a multiple-spindle machine having as many spindles as there were recesses to be machined was designed and built. The turret that carried the work was indexed intermittently, and all cutters fed into the work simultaneously, so that a completed piece was turned out at each indexing of the work-table.

Some accuracy was sacrificed in designing this equipment, in order to obtain greater production. The speeds and feeds required in taking the heaviest cuts did not permit the cutters used for the lighter cuts to be operated at the most efficient speeds and feeds. The cutter used with this equipment, as shown at *A* in the illustration, was also unsuited for the work. It consisted of a single-bladed mill, with the blade crossing the center so that it would not leave a projecting pin at the center of the recess. The outside edge of the blade determined the diameter, and consequently the life of the tool was comparatively short, as the diameter became too small after several regrindings.

The finish was not so good as that obtained by the traversing cut formerly used, and the appearance of the finished part was less attractive. Many times, through error in adjustment, regrinding, etc., a projection was left in the center, and this added to the difficulty of piercing the small hole at

the center of the recess for supporting the pivot bearing of the gear shaft. When the piercing punch encountered the small projection, it became deflected or broken, resulting either in a spoiled piece of work or inaccuracy in the location of the pierced hole. In spite of these defects, the machines were used for ten years, and during that time an amount equivalent to twice their original cost was paid out in an attempt to overcome the faults.

Upon the reorganization of the company, steps were taken to improve the production methods and equipment. The committee in charge of investigating production methods decided in favor of a semi-automatic single-purpose machine in which each tool would operate under the most favorable conditions with respect to feeds, speeds, accuracy, and quality. The design was required to be standardized for all operations, so that in the event of breakdowns, delays, etc., a minimum delay in production would ensue. Also the machine was required to be of a type that would not necessitate an increase in the number of operators.

After exhaustive tests, it was found that the nearest approach to ideal requirements could be obtained by employing an end-mill about 0.030 to 0.050 inch larger in diameter than the maximum radius of the particular recess to be machined. Upon experimenting, it was found that, by rotating the end-mill and the work, allowing two complete revolutions of the cutter to give the required depth of the cut and one revolution of the work with the cutter at the required depth to clean up the recess, all requirements were fulfilled.

The cutter for this purpose had from four to six cutting blades instead of one. It could be reground a number of times before being discarded and yet maintain the proper diameter of recess. In some instances a cutter, if too small for one recess, could be used for machining another recess. Adjustment for diameter could be obtained by changing the relation between the center of the cutter and the center of the recess.

The machine, as fully designed and set up for operation, is shown in the accompanying illustration. The main drive is obtained through the clutch *C*, change-gears *D*, and the shaft *E*, on which are mounted two worms. One worm drives a worm-wheel attached to the work-spindle *F*, and the other worm drives the camshaft *G* on the cutter-slide through a worm-wheel and spiral gear mounted on the vertical shaft *Z*. Camshaft *G* is splined, so that it can be adjusted or carried sidewise with the cutter-slide when screw *H* is turned, to obtain a variation in the size of the recess. End movement of the spiral gear *I* is prevented by the supporting bracket. This gear drives the camshaft through the medium of splines.

The camshaft carries three cams, the central one shown at *J* being employed for advancing the cutter *K* to the work. The cam at the left-hand side of cam *J* actuates the clutch *C* through an extension rod that comes in contact with lever *L*. This cam serves to stop the machine once every revolution of the camshaft by throwing the clutch out of mesh with the driving shaft. The cam at the right-hand side of cam *J* actuates the ejector *M* through the extension *N* and the lever *O*. The ejector removes the work from three locating pins (not shown) on the face of the work-table chuck. The locating pins engage three holes in the plate, which are used for locating it in each subsequent machining operation.

The ejector rod *M* makes contact with a spider *P*, which carries three ejector pins. The end of the ejector rod is so shaped that it engages the spider properly, regardless of which recess is being machined. This feature is necessary, as the spider in each chuck is so located as to present the ejector pins in a position adjacent to the working or locating pins and thus strip the plate from the working pins. Hence, the spider occupies a different position with respect to the center of each chuck, since the recesses are located in the plate at various distances from the center of the work.

Ample bearing surface is provided for the work-table. Adjustment for wear on the work-table is provided for by the adjusting nuts *Q*. The work-holding chucks are ground all over, and are made interchangeable in order to permit them to be transferred from one machine table to another. Thus in the event of any machine being shut down for repairs, the work can be transferred to another group of machines.

The spindle *R* is provided with a taper hole for the tool shank. This spindle runs in a steel quill having a bushing for the radial bearing. A ball thrust bearing at the lower end of the spindle serves to take the thrust of the cut. The quill is provided with a yoke *S* and an adjusting collar, so that the spindle can be raised or lowered with respect to the surface of the work-table. A compound lever *T* transfers motion from the arm to the quill. When the cutter has reached the required depth, the end of the collar *U* comes in contact with the thrust plate *V* and thus controls the depth of the cut. The drive from the spindle is obtained through the bushed pulley *W* by a key plate secured to the top of the pulley, so that all belt strains are removed from the spindle. The pulley is secured in place by lock-nuts.

In operating the machine, the work is placed on the table and the machine started by throwing in the clutch controlled by handle *Y*. The work-table makes two revolutions while the cutter is advancing to the required depth, and one revolution at the required depth to obtain the desired finish. The clutch is thrown out as the cutter rises, and the ejector then strips the work from the holder, leaving the machine idle and ready to receive the next piece of work. While the cut is being taken, the operator is free to load other machines.

* * *

RUSSIAN MACHINERY IMPORTS

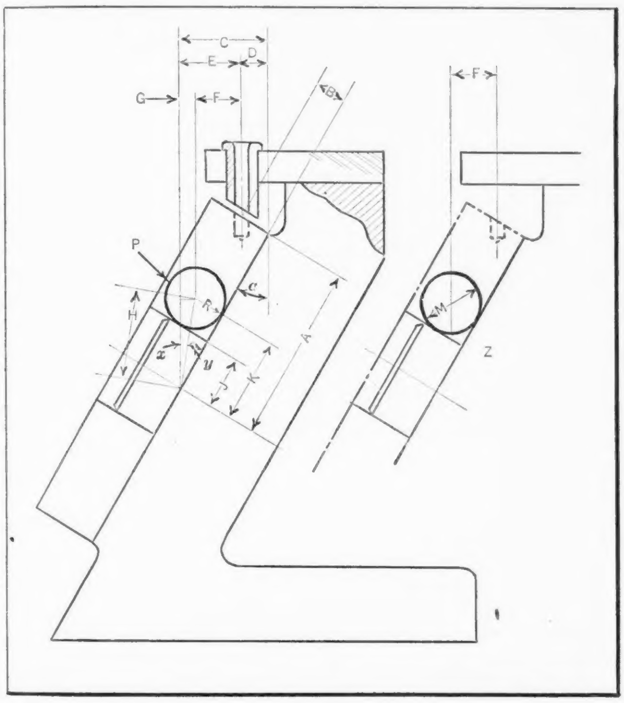
According to information published by the *Russian Review*, industrial equipment valued at $6,820,000 was imported from America into the Soviet Union during the fiscal year ending September 30, 1926. Of this, $726,000 represented machinery for the metal-working industry; $3,350,000, mining machinery; and $1,475,000, equipment for the oil industry. According to the same report, agricultural machines and implements were imported to a value of $1,425,000, and tractors and tractor equipment to a value of $6,100,000.

JIG FOR DRILLING HOLES AT AN ANGLE

By JOHN HOMEWOOD

On page 975 of August MACHINERY, there appeared an article entitled "Jig for Drilling Holes at an Angle" in which a jig having a hole in the body to facilitate the location of the drill bushing hole was described. The drilling of holes at an angle is often a source of trouble, and the method described in August MACHINERY should be of great assistance to many toolmakers.

There is another method, however, whereby the making of the hole in the body of the jig is unnecessary. With this method, a plug *P*, as shown in the accompanying illustration, rests upon the face of the central pin of the jig. This plug is used as a measuring surface instead of the hole drilled in the body of the jig. The known factors are *A*, *B*, angle *a*, the diameter of the measuring block



Jig for Drilling Hole at Angle

having a radius *R*, and radius *J*. If the distance from the center of plug *P* to the center of the hole to be drilled is given, the toolmaker can readily locate the hole for the bushing. Referring to the illustration, it will be noted that the important measurement *F* can be obtained by solving the following equations in the order given:

$$C = \sin a \times A \quad (1) \qquad D = \cos a \times B \quad (2)$$

$$E = C - D \ (3) \quad K = J + R \ (4) \quad \tan y = \frac{R}{K} \ (5)$$

$$x = a - y \ (6) \quad H = \frac{R}{\sin y} \ (7) \quad G = H \times \sin x \ (8)$$

$$F = E - G \ (9)$$

It may be well to mention here that a great saving of time in the tool-room will be made, and possibly costly mistakes avoided, if the toolmaker is given a sample lay-out or diagram, such as shown at *Z* in the accompanying illustration. In this diagram, only the diameter of the measuring block *M* and the measurement *F* need be given.

CHOOSING A WELDING ROD

By R. W. BOGGS

What should be the determining factors in selecting a welding rod? In the early days of oxy-acetylene welding, almost any kind of welding rod or wire was used, provided it filled the gap and was strong enough to hold together. In these days of high-speed work, however, the requirements are much more exacting, and we find considerable specialization in welding rods. The increased use of the oxy-acetylene process and the ever-widening field of application has made the user more discriminating in his choice of equipment.

The best welding rods on the market today are the result of years of exhaustive research and experiment. When a welding rod is subjected to the flame of a blowpipe, it undergoes not only a physical but also a chemical change. Various oxides are formed, which should come to the surface of the molten metal and form a protective coating, thus preventing oxidization of the metal. Since the majority of pieces joined by welding have their ends beveled to form a V-groove, so as to produce deep fusion of the pieces, it is imperative that the metal supplied by the welding rod should be of the best quality and produce metal in the joint that equals in reliability that of the parts welded. When a welding rod of poor quality is used the resulting weld will have slag or oxide inclusions. With a welding rod of this kind, the workman cannot, of course, do as good work as he could with a rod of good quality.

A welding rod that has been properly made will flow smoothly and will readily enter the oxy-acetylene flame without giving off sparks or fumes. When sparks are given off, some of the small pieces of burnt metal that fly in all directions will fall on the metal ahead of the weld and form a layer of oxide between the welding metal and the work, thus preventing perfect fusion. It is also very important that the welding rod should give a strength equal to that of the pieces welded. This is accomplished only by the use of a good quality rod.

Another consideration, which at first seems unimportant but which assumes a greater importance when handling large quantities of rod, is the matter of readily identifying the various rods. The different types of rod should be so marked that any one can be readily distinguished from the others. All steel and all cast-iron rods that are subject to rust should be protected to prevent oxidization, using materials for this purpose that will not affect its action or use in making a weld. The factors that should be considered in choosing a welding rod may be summed up as follows:

1. The composition of a welding rod should be such that the resulting welding metal will have the proper chemical and physical properties with respect to the base metal.
2. The composition of the welding rod should be such that the metal will flow readily and smoothly without excessive sparking.
3. The rod should be marked in some way so that it can be readily and accurately identified.
4. The welding rod should be purchased from a reputable manufacturer, and his name should be stamped upon each rod as a guarantee of its quality.

The Machine-building Industries

THE lessened industrial activity in December and January, due largely to the seasonal decline in the production of automobiles, created some hesitancy on the part of business men, and in some directions production showed a measurable decline. However, the increased activity in the iron and steel field, the resumption of larger schedules in the automotive industry, continued building activity, and well maintained railroad traffic, with the prospects that the railroads will be in the market for more equipment and rolling stock this year than for many years past, have, to a large extent, changed hesitancy into confidence.

Even the decrease in industrial production in December, the last month for which complete statistics are available, was by no means such as to warrant the pessimistic views expressed in some quarters, for the production, while less than that of the preceding months, was still 5 per cent greater than the average monthly production for the three preceding years. The decline was due entirely to recession in the manufacturing industries, mainly the automotive industry, while the output of minerals was at a record level in November and showed only a slight decline in December.

Increased Activity in the Iron and Steel Industry

The iron and steel industry, as mentioned, shows a distinct improvement. January shipments were about 15 per cent greater than those for December. Ingot production averages close to 80 per cent of capacity for the country as a whole, with the United States Steel Corporation working at 86 per cent. The pig iron output in January was slightly larger than in December, and a few additional furnaces were blown in during the latter part of the month. Orders for structural steel have increased.

No Marked Change in the Machine Tool Industry

In general, the machine tool industry had a better month in January than was expected by many manufacturers, and the early part of February showed no indication of a decline. Grinding machine manufacturers, especially, have experienced considerable buying activity, and several manufacturers of sensitive drilling machines and bench lathes are doing an unusually good business.

In the small tool industry, the last three months have been comparatively quiet, due principally to the limited activity in the automotive plants. With the increased manufacturing schedules put into effect in most automobile plants in February, a greater demand for small tools was noticeable. The tap and die industry is working at what must be considered fully normal activity, although present demand probably does not require more than about 70 per cent of the manufacturing capacity in this field. Somewhat similar conditions exist in the twist drill manufacturing field, but the business as a whole is healthy, and without question is in a better state today than at any time since the war.

The grinding wheel business is active, and the last two years are generally considered as normal years by grinding wheel manufacturers. In this industry there is not a great deal of over-capacity at present, as the demand for grinding wheels has increased sufficiently to take up the slack that existed in all industries when the war demand ceased. Between 1895 and 1920, the output of grinding wheels doubled approximately every five years. This ratio of increase obviously was not maintained between 1920 and 1925, but the output of the industry today is probably not far, if at all, behind the average output during the war years.

Production Schedules Are Increasing in the Automobile Field

Automobile factories are gradually increasing their production, and at present many plants have reached full volume schedules. The recent curtailment in production has aided in reducing stocks in dealer's hands to a level that may be considered fully satisfactory at the beginning of the active spring season. General Motors and Hudson-Essex production schedules show sharp advances, it being reported that 1000 Buick, 3000 Chevrolet, 500 Hudson, and 700 Essex cars are manufactured per day. Nash is also on a big production schedule, and many other manufacturers have increased their outputs similarly, although exact figures are not reported. In 1926, Ford manufactured over 1,800,000 cars.

Great gains are expected in the use of commercial vehicles abroad, which will have a marked effect on the 1927 export trade. Numerically, the passenger car export business will be the largest part, but the percentage of increase in export business during 1927 will very likely be much larger for trucks and buses than for passenger cars.

The Railroad Situation Inspires Confidence

Railroad executives look forward to a year of prosperity in the railroad field, and are confident that the record of the last year will be maintained or surpassed. The accomplishments of the railroads last year indicate how successful have been the efforts of railroad managers to increase the efficiency of operation. Car loadings exceeded 52,000,000 cars during the year, the highest on record, being approximately 3 per cent more than for 1925 and 15 per cent more than in 1920. Measured in ton-miles, the transportation performance in 1926 exceeded 1925 by 7 per cent. The average movement of freight cars per day reached a new record in October of 34.3 car miles.

During 1927 it is estimated that the railroads will spend at least $875,000,000 for improvements. Of this, about 40 per cent will be spent for equipment of different kinds, rolling stock, etc., while 60 per cent will be spent on roadway improvements. It is expected that there will be heavy buying of cars and locomotives.

New Machinery and Tools

The Complete Monthly Record of New Metal-working Machinery

BAKER HYDRAULIC BORING AND DRILLING MACHINE

The latest addition to the line of machine tools built by Baker Bros., Inc., Toledo, Ohio, consists of a No. 50 H hydraulic vertical boring and drilling machine known by the name of "Twin Pull." This name is derived from the fact that hydraulic cylinder equipment is provided on each side of the machine to pull, instead of push, the spindle head toward the work. The piston-rods of the two hydraulic cylinders are operated simultaneously.

Various sizes of this production type machine can be built to suit the work. Because of the simple design, the machine can be greatly modified as to clearances, number of spindles in the head, center distances between spindles, etc. It is particularly adapted for use with an indexing table or fixture, either for successive operations on the same piece or for a long drilling operation which it is desirable to break up into several steps on account of excessive wear of the drill and inability to cool the drill properly or withdraw the chips.

In an operation of this kind, the work can be indexed to the first station and drilled part way through, indexed to the second station and drilled further, and so on, until the part is finished. With this method, a coarser feed can be used than when holes are drilled in one step, which results in increased production and reduced drill wear. It is stated that the machine has been placed on work where a drill had to be reground or changed for every thirty pieces when the operation was performed on a single-spindle machine, while with the new machine, the drills could be used all day and production was increased.

The head carrying the spindles is mounted on a saddle which moves on scraped ways. The two hydraulic cylinders furnish a smooth feed to the head, the feed being entirely automatic after it has been started by a foot-pedal. The mechanism advances the head quickly to the work, after which it feeds the head at the proper rate, quickly reverses it at the end of the operation, and stops it at the top of the stroke.

The rate of feed and the positions at which the "hurry-up" feed starts and stops can be quickly changed by making adjustments. This hydraulic feed is obtained by means of oil, an Oilgear pump being employed. On multiple-spindle machines, all spindles have a vertical adjustment to compensate for different drill lengths.

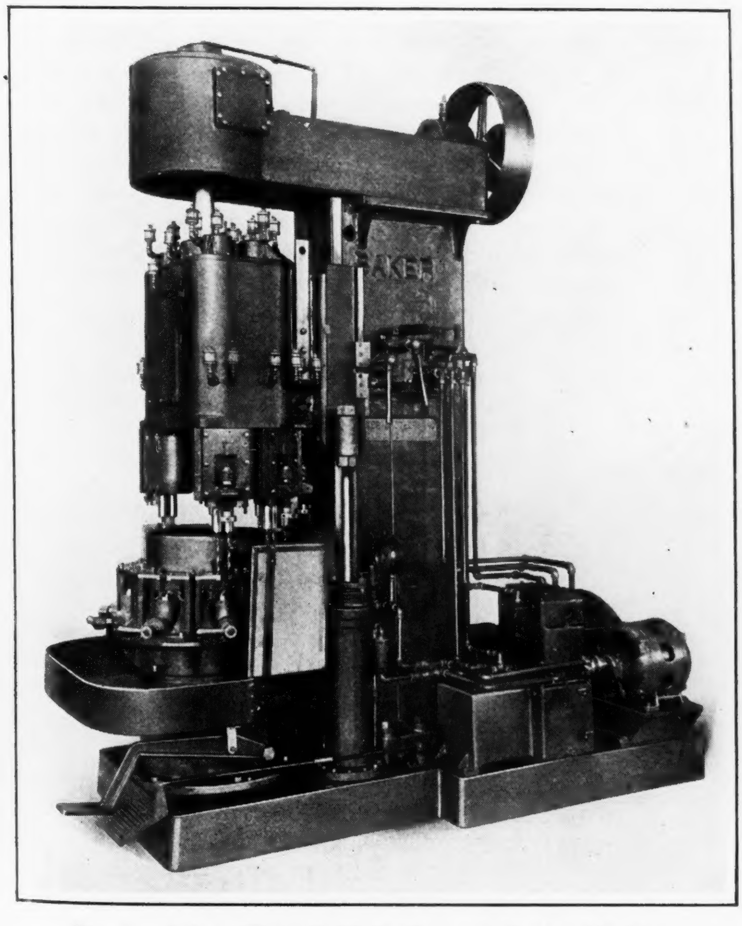


Fig. 1. Baker "Twin Pull" Drilling and Boring Machine with Oilgear Feed

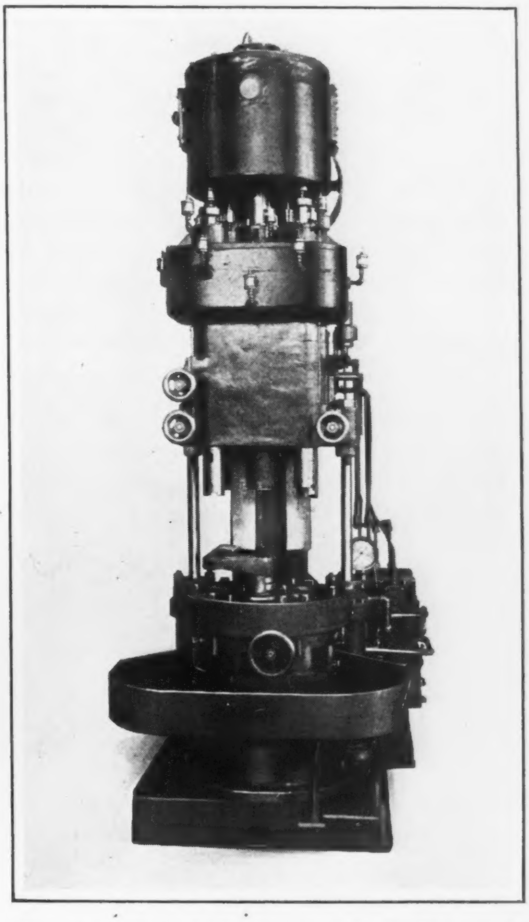


Fig. 2. "Twin Pull" Five-spindle Drilling and Boring Machine

The machine can be furnished with either a belt or motor drive. With a motor drive, two motors are required, one from 10 to 40 horsepower, depending upon the work, for driving the machine itself and another of about 3 horsepower, for driving the hydraulic feed mechanism. The weight of the machine with a five-spindle head and without fixtures, table, or tools is approximately 4 tons.

In Fig. 1, a motor-driven machine is shown provided with a nine-station table which is indexed into three positions. The machine is equipped with six two-spindle heads for drilling forged crankshaft counterbalances. Two holes are drilled in each counterbalance, approximately 1/2 inch in diameter and 2 1/2 inches deep. After three fixtures have been loaded, the table is indexed 180 degrees. Then the drills in the first three multiple heads drill half way through the pieces. The pieces are next indexed to the remaining three spindles, where the drilling of the holes is completed.

Fig. 2 shows a five-spindle machine arranged for drilling forged hubs. Each of the first three spindles drills through one-third of the work. Thus, the drilling is completed when the parts reach the fourth spindle, which is equipped for a rough-taper-reaming operation. The fifth spindle is employed for a finish-taper-reaming operation. It will be seen that there is a guide bushing under the first spindle, to start the drill correctly into the work.

BILTON DOUBLE-SPINDLE "PRODUCTO-MATIC"

A special adaptation of the "Producto-Matic" milling machine was recently made by the Bilton Machine Tool Co., Bridgeport, Conn., to provide for the rapid milling of steel roller-chain bushings. The operation consists of simultaneously milling two flats on the opposite ends of two bushings by the use of eight milling cutters. An important requirement is that the flats on the opposite ends must be in line and parallel with each other. A four-station work-holding fixture permits the reloading of parts while an operation is in process. On bushings 57/64 inch outside diameter by 2 1/8 inches long, the production averages 600 per hour.

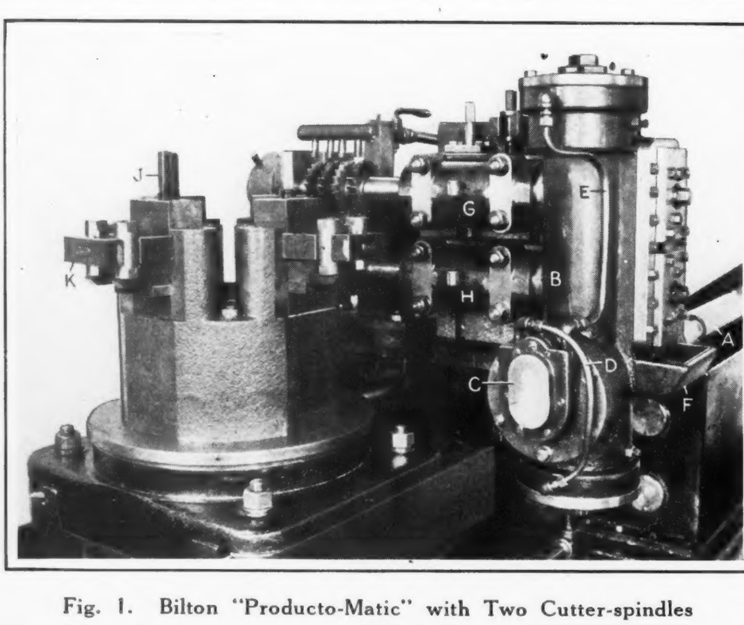


Fig. 1. Bilton "Producto-Matic" with Two Cutter-spindles

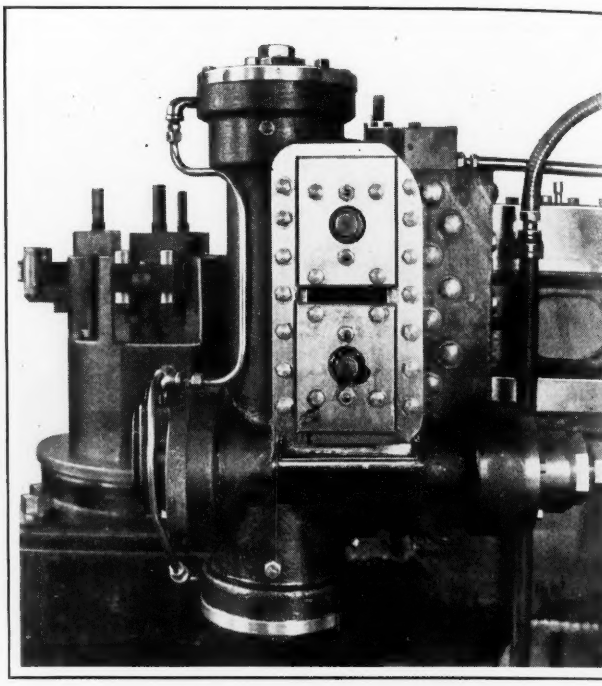


Fig. 2. End View of Spindle Unit

Reloading of the work is performed manually, but otherwise the operation of the machine is entirely automatic. Two cutter-spindles are provided so that four cutters, mounted on the upper spindle, can machine the top ends of two bushings, while four cutters on the lower spindle cut the bottom ends of the same pieces. The double-spindle unit is driven through the regular universal shaft *A*, Fig. 1, the machine being of standard construction, with the exception of the mechanism provided for driving the two spindles.

Shaft *A* drives a horizontal shaft which revolves in Timken tapered roller bearings within housing *B*. A bevel gear mounted on the front end of the second shaft drives a vertical worm-shaft also contained in housing *B*. The worm is of extra length and drives a bronze worm-wheel mounted on the right-hand end of each cutter-spindle. The length of the worm permits changes in the center distance between the two cutter-spindles to suit the work. Timken tapered roller bearings are also provided at the top and bottom of the worm-shaft, and there is an adjustable thrust bearing at each end. In addition to the bearings within blocks *G* and *H*, both cutter-spindles revolve in bearings at the left-hand end of the machine.

Automatic lubrication of all members in housing *B* is accomplished by means of a pump which is mounted on the inner side of plate *C* and driven by the bevel gear of the vertical worm-shaft. This pump draws oil through pipe *D* from the lower portion of housing *B*, which serves as a reservoir, and delivers the oil through pipe *E* to the top of the housing. Here the oil is discharged into the housing and cascades downward over the worm-shaft, worm-wheels, and other important parts. The pump delivers about 1/2 gallon of oil per minute. Any oil that may ooze out of the cutter-spindle bearings is caught by pan *F* and drained back into the reservoir.

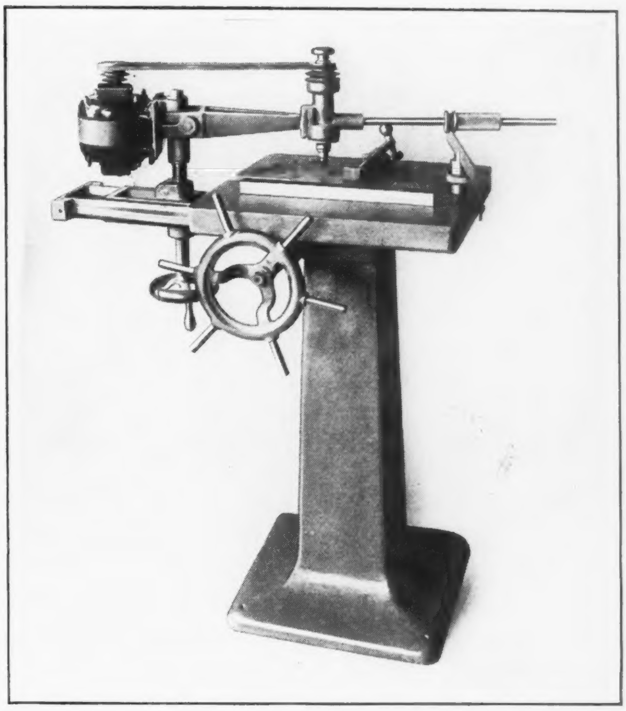
The reservoir is also replenished from this pan. Clamping and unclamping of the work are quickly accomplished by operating the proper screw J for tightening and loosening the corresponding clamp K. Each clamp holds two parts in the vees of a stationary block. Arrangements are made for a copious supply of coolant to the cutters.

OLIVER PROFILING MACHINE

On a profiling machine recently brought out by the Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich., the spindle is on the end of a swinging arm and can be moved freely to any part of the table. The work is clamped solidly to the table, and the cutter guided by hand. The swinging arm also has a limited vertical movement to permit raising the cutter over the work so that it can be entered into an opening. A fixed stop on the arm insures that the cutter-spindle is vertical when the arm is down. There is a further vertical adjustment of the spindle to adapt it to various thicknesses of work. This adjustment is made by means of the supporting screw.

The swinging arm and motor are mounted on a carriage which may be traversed by revolving a handwheel to actuate a rack-and-pinion mechanism. This handwheel can be located on either side of the machine to suit a right- or left-hand operator. The spindle is guided and held in contact with the work by the rod that extends forward from the swinging arm. This rod controls the swinging motion. It is equipped with a knurled grip which slides on the rod and has a pinion that engages a rack attached to the table. When the direction of the cut is at right angles to the arm and the force of the cut has a tendency to move the arm, this movement can be prevented by grasping the grip. The pull of the cutter then comes against the rack teeth. This arrangement permits the control of the cutter under any condition. End-mills, formed cutters, or rotary files can be employed.

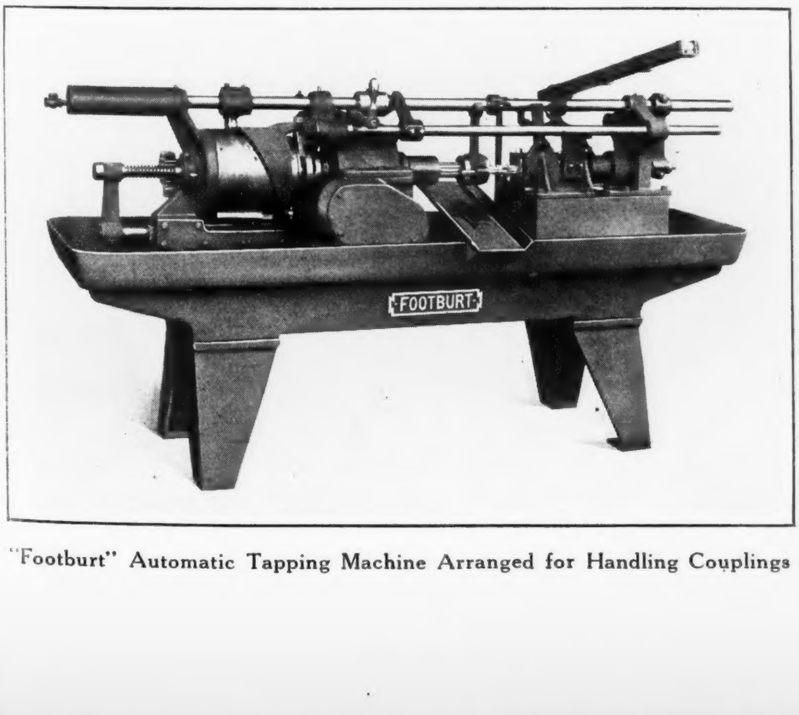
The machine can be used for diemaking, metal patternmaking, cam cutting, engraving, embossing, horizontal and vertical profiling, and similar operations. These operations can be performed either free-hand or by employing a templet. To accommodate the wide range of work, spindle speeds of from 800 to 8000 revolutions per minute can be arranged for. The table is 22 inches square, and the spindle can be moved over an area measuring about 12 by 20 inches. A 1/4-horsepower motor drives the spindle. This machine weighs about 375 pounds, and occupies a floor space of 2 by 3 feet.



Oliver Profiling Machine with Swinging Arm

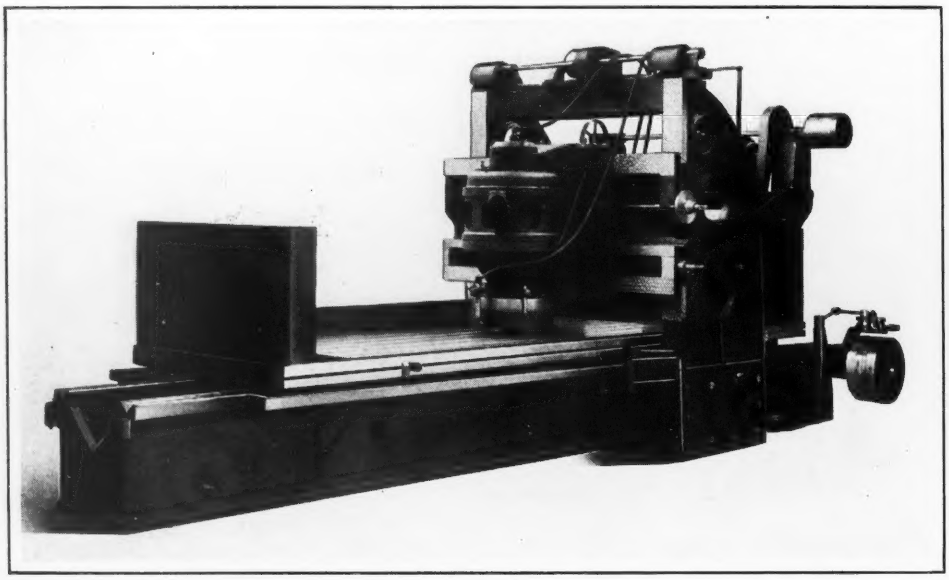
"FOOTBURT" HORIZONTAL AUTOMATIC TAPPING MACHINE

A single-spindle horizontal automatic tapping machine is the latest development of the Foote-Burt Co., Cleveland, Ohio. The machine as illustrated is arranged for tapping couplings, but it can also accommodate other work. High rates of production are claimed, it being mentioned that in tapping 1/2-inch steel couplings 1 5/16 inches long, a production of ten couplings per minute can be maintained. The machine is entirely automatic in action, the only work required of the operator being to keep the magazine loaded with couplings. From the magazine each coupling automatically passes through the machine until it is tapped, and then drops on the slide at the front of the machine, from which it rolls into a container.



"Footburt" Automatic Tapping Machine Arranged for Handling Couplings

Two vises are used to hold the couplings, and each coupling is shifted from one vise to the other during a machine cycle. All the actual tapping is done while the coupling is clamped in the first vise. The construction of the machine is such that it is not necessary to pass the entire threaded part of the tap through each individual coupling before another coupling can be tapped, or to back the tap out of the coupling after the threads are produced. While



Springfield Vertical-spindle Surface Grinder

one coupling is being completed, another coupling is being tapped.

In operation, there are always two couplings in the vises and at least one finished coupling on the shank of the tap. As the end of the tap breaks through the coupling it pushes a bar and trips a drum cam, which then makes one complete cycle. During this cycle, as soon as the coupling has been tapped, the spindle moves back from the tap and a stripper attached to the spindle pulls the completed coupling off the tap shank. The bar pushed by the tap is moved back far enough to allow a coupling to fall from the magazine into position before the first vise.

The jaws of the vises then automatically release the couplings held by them, and the bar returns, pushing the new coupling into place in the first vise and the tapped coupling, with the tap, into the second vise. The coupling that was in the second vise is pushed back on the shank of the tap, ready to be pulled off by the stripper during the next cycle. The jaws of the vises then automatically clamp the couplings that have been advanced to them, the spindle moves forward to the tap, and the tap starts revolving. The finished coupling in the second vise leads the tap in tapping the coupling in the first vise.

Both vises have three jaws, two of which are stationary and one movable. The movable jaws are vertical and are controlled simultaneously by means of a cam. The pressure exerted on the couplings is no greater than is actually necessary to hold them, and therefore the couplings are marked but little by the vises. This machine is manufactured in two sizes, the small size being intended for from 1/2- to 1-inch couplings and the large size, for from 1 1/4- to 2-inch couplings.

SPRINGFIELD VERTICAL-SPINDLE SURFACE GRINDER

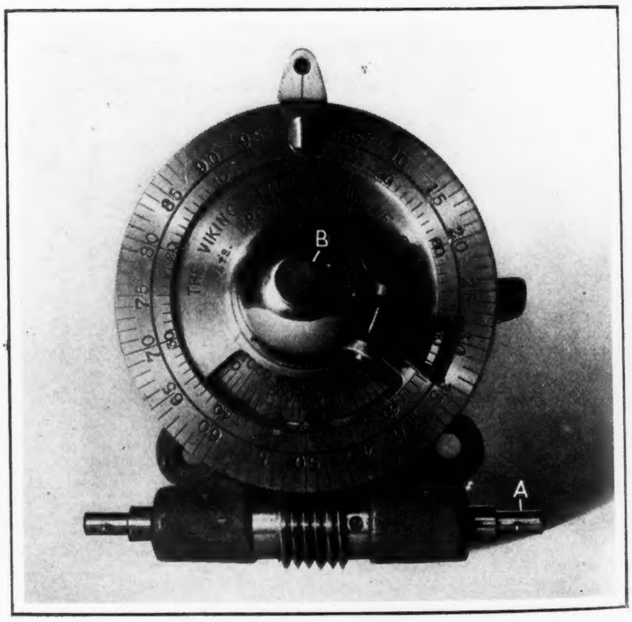
A vertical-spindle surface grinding machine equipped with a wheel-head having a built-in motor drive constitutes a recent development of the Springfield Mfg. Co., Bridgeport, Conn. This machine has a capacity for grinding work up to 10 feet long, 4 feet wide, and 2 feet high under the grinding wheel. A 30-horsepower alternating-current motor is provided, the rotor being mounted directly on the grinding wheel spindle.

The spindle revolves on heavy-duty ball bearings. A large oil reservoir is provided for each ball bearing and a revolving splasher insures constant lubrication. The upper ball bearing is mounted in a specially designed cage, equipped with a series of compensating springs which automatically keep the grinding wheel spindle free from play or backlash. The spindle is drilled its entire length so that cooling compound can be supplied to the inside of the grinding wheel. An 18-inch ring wheel is used. It is held in a chuck by means of a bronze clamping ring, the chuck, in turn, being bolted to the spindle faceplate. The chuck can be readily removed for wheel replacement.

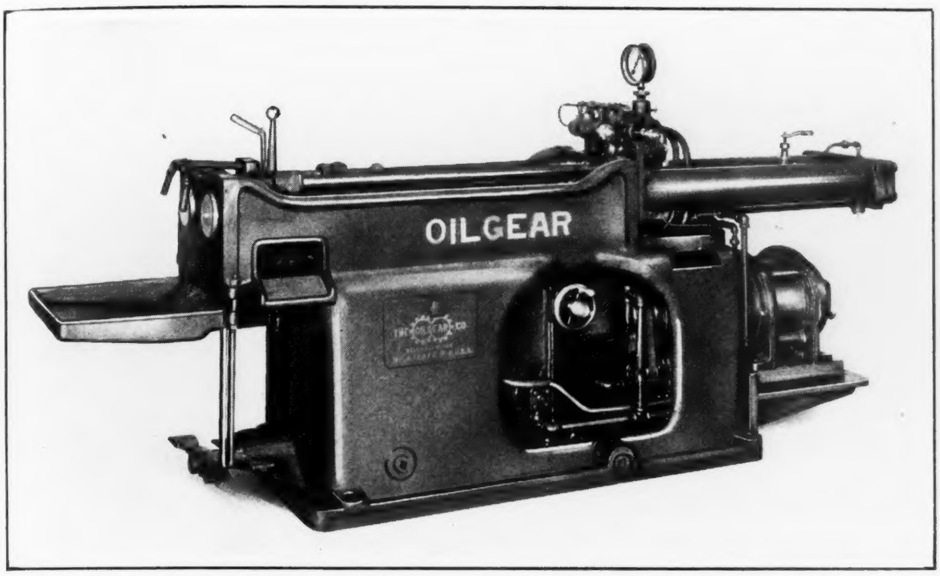
Power for traversing the table is furnished by a 7 1/2-horsepower motor mounted on a platform between the uprights. This motor is also used for elevating the cross-rail and for driving the water pump. A large coolant tank located at the rear of the bed is readily accessible for cleaning and filling. This machine weighs approximately 15 tons.

VIKING IMPROVED STOP-COUNTER

Several important improvements have recently been made in the construction of the stop-counter manufactured by the Viking Tool & Machine Co., Inc., 745-59 Sixty-fifth St., Brooklyn, N. Y., which was described in December, 1926, MACHINERY. The improved device, which is here illustrated, automatically locks itself at zero when it is turned backward, and hence, a machine attendant does



Viking Stop-counter of Improved Design



Oilgear Broaching Machine for Small and Medium-sized Work

not need to look at the graduations while resetting the counter for subsequent operations in quantity production manufacturing.

Another advantage is that the wormwheels of the improved counter can be adjusted without taking the device apart, in order to stop a machine after any given number of revolutions of worm-shaft *A* which actuates the wheels. At any time in the operation of the counter, it is possible to determine at a glance exactly the number of revolutions made by the worm-shaft after the machine was started. Improvements have been made in the construction of the counter details, and there are now only three moving parts.

An electrical connection is made at the rear of the device to provide for stopping the machine to which the device is applied after any predetermined number of revolutions of worm-shaft *A*. In the previous model, the electrical connection was made at the front, which obstructed the view of the graduations. When the device is arranged for controlling a machine electrically, the machine can be stopped at any time by simply depressing button *B*.

The counter may be designed for controlling a machine mechanically instead of electrically. There may also be a combined electrical and mechanical control, so that the machine can be stopped without stopping the motor, and the motor readily stopped when desired. With this counter, various types of machines can be stopped after worm-shaft *A* has been revolved any predetermined number of times from 0 to 9900.

OILGEAR HIGH-SPEED BROACHING MACHINE

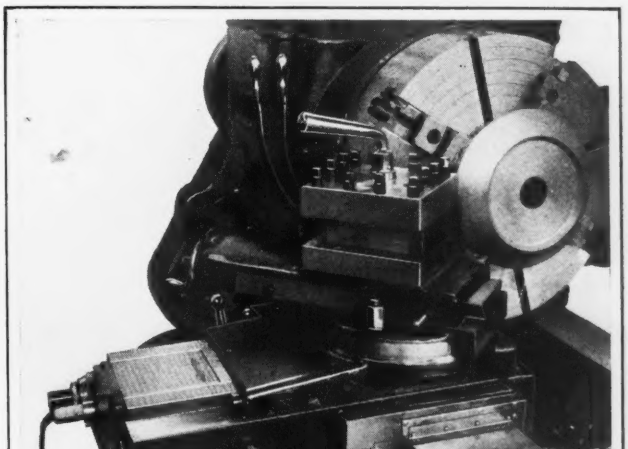
The latest addition to the line of hydraulic broaching machines built by the Oilgear Co., 660 Park St., Milwaukee, Wis., is of double-spindle design and is known as the "Twin Ten." When this machine is in operation, one spindle is on the working stroke while the other is making the return stroke. This arrangement, coupled with the high-speed operation, gives a production that is limited by the speed of the operator rather than by the speed of the machine. Both a hand and double foot-pedal control are arranged for. The oil pressure is obtained from a type W pump, which is an integral part of the machine. This pump may be driven from any lineshaft or belted to a motor.

The machine is especially adapted to high-speed broaching on small and medium sized parts. It is capable of making about five hundred 36-inch strokes or nine hundred 18-inch strokes per hour. The normal pulling capacity of the machine is 10,000 pounds, but the peak pulling capacity is 12,000 pounds. The stroke is adjustable from 6 to 36 inches, and the speed, from 48 to 360 inches per minute. The net weight of the machine is 3000 pounds, and the floor space required, 32 inches by 10 feet.

COMPOUND SLIDE FOR GISHOLT TURRET LATHES

A compound slide provided with a power angular feed has recently been developed by the Gisholt Machine Co., Madison, Wis., for application to the 3L, 4L, and 5L geared-head turret lathes made by that concern. This compound slide facilitates the machining of bevel gears and other parts having a steep taper. The slide can be swiveled through the full 360 degrees, and hence, the tool can be fed by power in any horizontal direction. The upper slide has a travel of 6 inches on the 3L machine, and 9 inches on the 4L and 5L turret lathes. The square turret toolpost can be used to turn or face diameters up to the full swing of the machine.

The compound feed and the cross-feed, which are both operated by hand and power, are entirely independent of each other. The power feed to the cross-slide is automatically disengaged when the power feed to the upper slide is engaged. Graduated index dials are furnished for both feeds. The



Gisholt Compound Slide with Power Angular Feed

number and range of feeds are the same as those of the side carriage longitudinal feeds. The compound-slide toolpost is not a single-purpose unit, as it can also be employed on the same work as the standard toolpost.

HARRINGTON HYDRAULIC MULTIPLE-SPINDLE DRILLING MACHINE

All movements of the spindle head on a multiple-spindle drilling machine recently developed by the Harrington Co., 17th and Callowhill Sts., Philadelphia, Pa., are actuated hydraulically. The machine was designed primarily for drilling up to twelve holes 1 5/16 inches in diameter simultaneously in the web of heavy steel girder sections used in bridge and building construction. These sections range from 8 to 31 inches in height, and up to 3 inches in flange thickness. Machines installed in shops for this purpose are being equipped with spacing tables to facilitate moving the girders beneath the drill spindles.

Rapid-traverse, feeding, and quick-return movements of the spindle head are obtained through Oilgear equipment. The oil-pump and its driving motor are located on the left-hand side of the machine. The pump unit consists of two elements, a constant-delivery low-pressure geared pump for the rapid traverse, and a variable-delivery high-pressure pump for the feeds. Both units deliver oil under pressure to two cylinders *A*, Fig. 1, which are mounted on top of the machine. Piston-rods extending from the lower ends of these cylinders are connected to each side of the spindle head directly in front of the gibs. These rods push the head downward for the rapid traverse and feeding movements, and pull it upward for the quick return. The pump is of the QH type.

Flexible and accurate control of the head movements is obtained by means of three long bars *B*, Fig. 3, which are fastened in a holder *C* attached to one side of the spindle head. Bars *B* are of slightly different widths and are positioned to make the upper ends project beyond each other a certain amount, depending on the desired length of rapid traverse and feeding movements. At the beginning of an operation, with the spindle head in the uppermost position, either pedal *D*, Fig. 2, or handle *E*, Fig. 3, is depressed to open the control valve of the Oilgear pump. At the same time the operating trigger *J* attached to handle *E* is brought in contact with the widest of bars *B*.

The spindle head then traverses rapidly toward the work until the operating trigger *J* slips off the upper end of the widest bar and engages the bar of intermediate width. As this occurs, a coarse feed of the head is automatically obtained until the drills start breaking through the work. Then the operating trigger *J* slips from the intermediate bar and engages the narrowest bar to automatically obtain a fine feed of the spindle head for the completion of the drilling. When the operating trigger slips off the third bar, the quick return is automatically engaged until the spindle head reaches the uppermost position, at which time the oil-pump automatically stops delivering oil.

Any length of rapid traverse, coarse feed, or fine feed can be obtained by merely setting bars *B* to suit. Further flexibility of the feed control is obtainable, as the oil equipment can be set to give any rate of feed between 0 and 20 inches per minute. Ordinarily, the rapid traverse and quick return are at the rate of 120 inches per minute.

Safety is a feature of the hydraulic control, there being a relief valve which functions to stop the downward movement of the spindle head in the

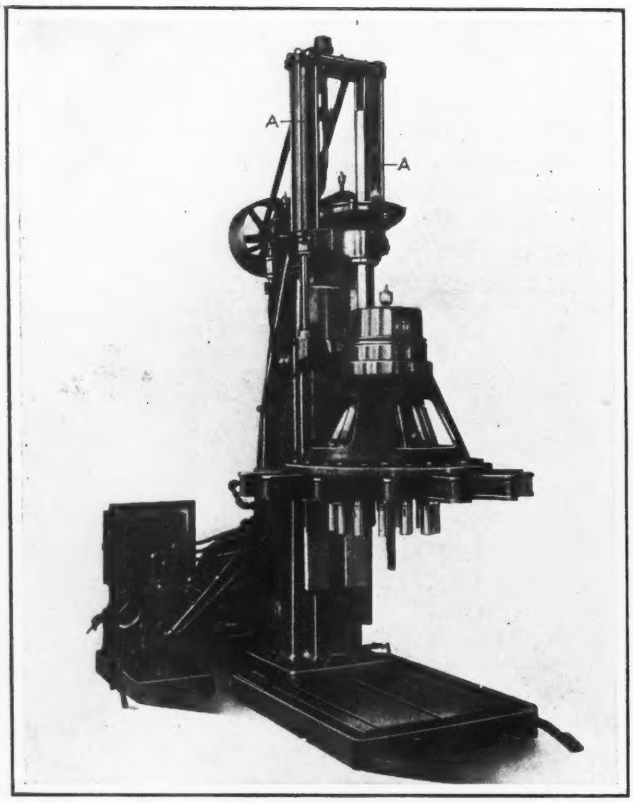


Fig. 1. Harrington Multiple-spindle Drilling Machine with Oilgear Equipment

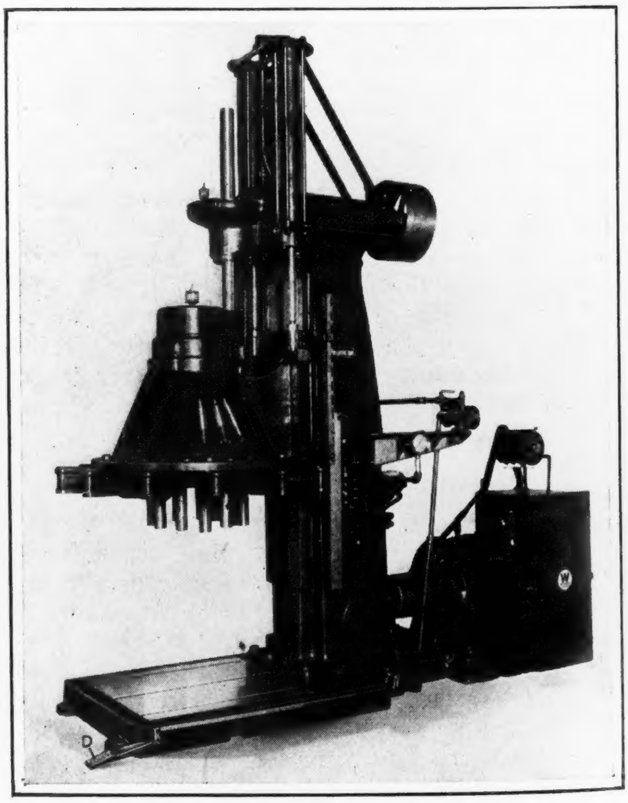


Fig. 2. Right-hand Side of the Hydraulic Drilling Machine

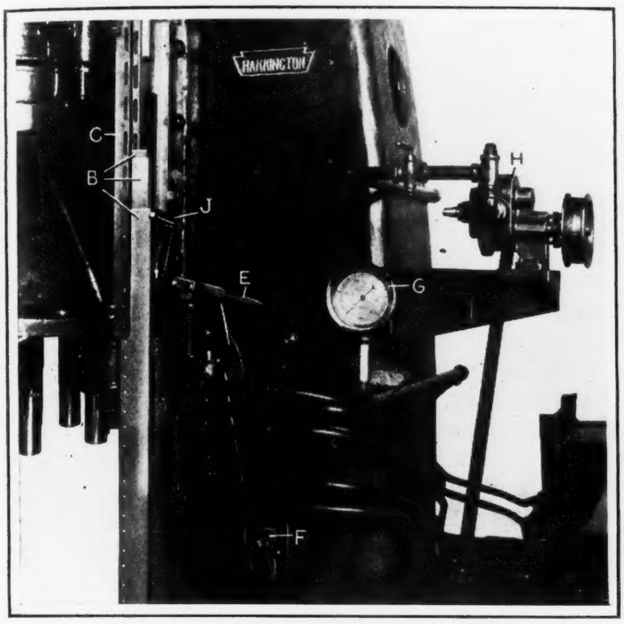


Fig. 3. Mechanism that Controls the Head Movements

event that the head or drills become jammed against the work or any other object. Also, handle E can be tripped at any time during an operation to instantly engage the quick return. Then, too, the oil-pump motor can be stopped immediately by pushing the stop-button of the push-button switch F which is mounted on the column. Gage G shows the pressure in the hydraulic line at all times during an operation, and indicates to the operator whether the desired amount of pressure is being used or whether undue pressure is required because of dull drills, etc.

The machine itself is the standard No. 63-B vertical machine that has been built by the Harrington Co. for a number of years. It is driven by a 40-horsepower motor which can be quickly started and stopped through the push-button switch mounted on the cabinet seen at the right in Fig. 2. Two complete sets of spindles are provided. The large spindles, size No. 9, will drive 1 5/16-inch drills on 2 3/4-inch minimum centers, while the small spindles, size No. 6, will drive 7/8-inch drills on 2 1/4-inch minimum centers. These spindles can be interchanged quickly as the occasion demands. All spindle units are of the patented "Screw-Lock" type which is provided with a self-locking device that prevents the spindle from slipping after an adjustment has been made to suit the drill length. The spindles can be adjusted without moving the radius bars. The "Oil-Well" universal joints are constructed with an internal oiling system, by means of which oil is thrown by centrifugal force into the trunnion bearings of the universal joints while the joints are in motion.

Quick-change chucks are furnished, so that drills can be removed instantly when not required. This is an important feature in drilling girders, because, while the rivet holes are usually spaced with standard center-to-center distances both ways, different numbers of holes are usually drilled in the various locations along the girders. All spindle gears are made of alloy steel and heat-treated. Coolant is supplied copiously to the drill spindles by pump H, Fig. 3.

The weight of the standard motor-driven No. 63-B machine, without the motor, is approximately 13,500 pounds. Other important specifications are as follows: Vertical traverse of spindle head, 34 inches; maximum distance from flange of spindle head to base, 57 inches; and distance from center of spindle head to column face, 23 inches. The over-all height of the hydraulically controlled machine is 13 feet.

MOLINE RAIL DRILLING MACHINE

Twenty holes up to 1 inch in diameter can be drilled simultaneously in steel rails on a machine recently built by the Moline Tool Co., Moline, Ill. The maximum distance between the two end spindles of this machine is 20 feet 5 inches. The minimum distance between adjacent spindles is 4 inches, with the exception of the two center spindles which have a minimum center-to-center distance of 5 1/2 inches. An in-and-out adjustment of 3 inches is provided for the spindles.

The table is of box section, well ribbed, and serves as a reservoir for the cutting compound. There are four uprights which are bolted to the bed and further tied together at the bottom by an 18-inch steel I-beam, and at the top by a 12-inch steel channel section. The construction provides rigidity for the sliding rail A which carries the drill spindles. The total travel of this rail is 30 inches. The sliding unit is counterbalanced by weights attached to chains carried by sheaves B.

Moline Rail Drilling Machine with Twenty Adjustable Spindles

The driving mechanism is located on the left-hand end of the machine. Power is delivered by a 40-horsepower motor, equipped with a two-step cone pulley, which is belted to a larger cone pulley on the main drive shaft. A wide idler pulley acts as a belt tightener. Power is transmitted from the drive shaft to the main spiral shaft through belts and then to the driving head *C* of each spindle by a 3-pitch spiral gear.

Each driving head is laterally adjustable on the upper rail and transmits power through a shaft and universal joints to a pinion shaft on the corresponding driven head *D* which is fastened to the lower rail. The pinion shaft meshes with a gear on the drill spindle and gives a further reduction in speed. The drill spindles are fed down together, but they have 1 inch of independent adjustment to take care of varying lengths of drills.

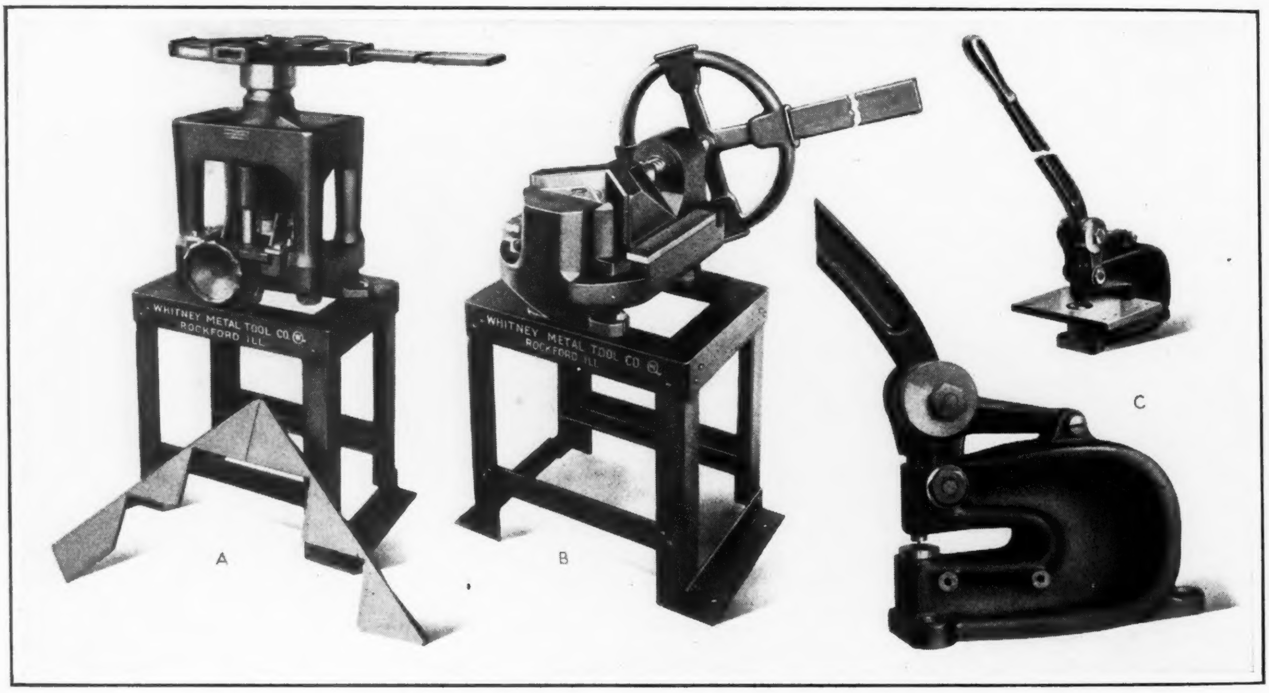
The feeding cycle of the machine is semi-automatic, and is accomplished through a unit mounted on the right-hand end of the machine. When the operator shifts lever *E*, he engages a quick-traverse clutch. The spindles are then brought down quickly to the work, at which point the rate of feed is automatically reduced for drilling. When the work has been drilled, the quick-return mechanism is automatically engaged to return the drills to the starting position.

The machine is shown equipped with a trough jig which is provided with an in-and-out adjustment to suit various sizes of rails. It is supplied with adjustable plates for the drill guide bushings. The work is clamped in position by means of hand-wheels *F*. This machine weighs approximately 50,000 pounds, and requires a floor space of about 6 by 23 feet.

WHITNEY NOTCHER, BENDER AND PUNCH

Three new products—a No. 60 notcher, a No. 61 bender, and a No. 16 bench punch—are being introduced to the trade by the Whitney Metal Tool Co., Rockford, Ill. The notcher, which is illustrated at *A*, is equipped with a patented ball-bearing spindle and a 5-foot lever, by means of which an ordinary person can create a pressure of approximately 60 tons at the shearing blades. This high pressure is said to eliminate almost entirely the ordinary wear and tear on the shearing punch and die. The machine is made purposely for notching angle-irons. It has a capacity for angle-irons up to the 3- by 3- by 3/8-inch size.

On the bender, which is illustrated at *B*, a pressure of approximately 60 tons can also be created by the same type of mechanism as that embodied in the notcher. Angle-irons up to 3- by 3- by 3/8-inch can be bent to a 90-degree shape. While the machine is regularly equipped with dies for bending angle-irons, special jaws can be used to bend pipe, flat or round stock, etc. The machine can also be used as a coin press on account of the great pressure that may be developed.



Three Recent Products of the Whitney Metal Tool Co.

The bench punch is shown at *C*, and is so designed that the operator works at the front where a good view can be had of the work. A convenient work-table can be used with this punch. In this table holes are drilled and tapped, so that stops or straightedges can be fastened to the table to facilitate the duplication of parts. The ample leverage permits easy and quick operation of the machine.

STANDARD ELECTRICAL TOOL CO.'S DEVELOPMENTS

Improvements have recently been made in several grinders and buffers built by the Standard Electrical Tool Co., 1938-46 W. Eighth St., Cincinnati, Ohio. Fig. 1 shows a motor-driven grinder that is built in two sizes, of 3 and 5 horsepower, respectively. This grinder is equipped with a controller which is located on the inside of the pedestal and operated through the push-button station mounted on the motor housing. The armature

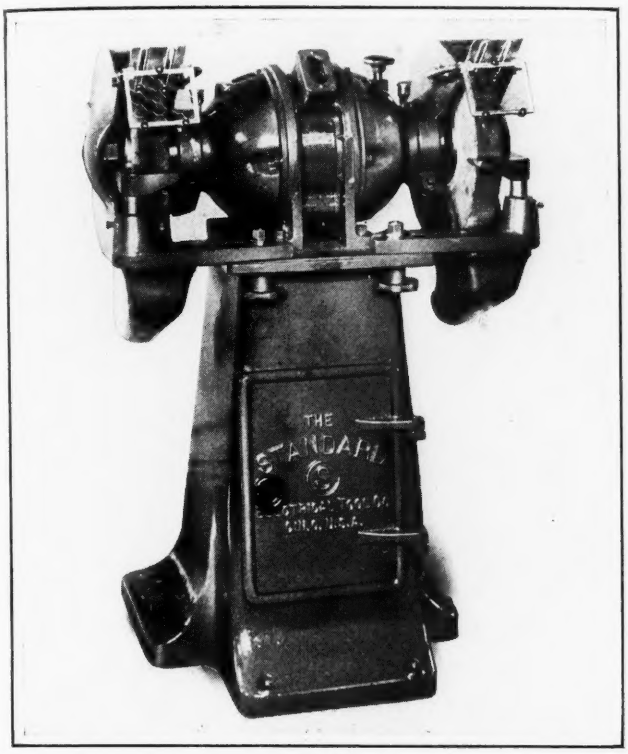


Fig. 1. Motor-driven Grinder Built in Two Sizes

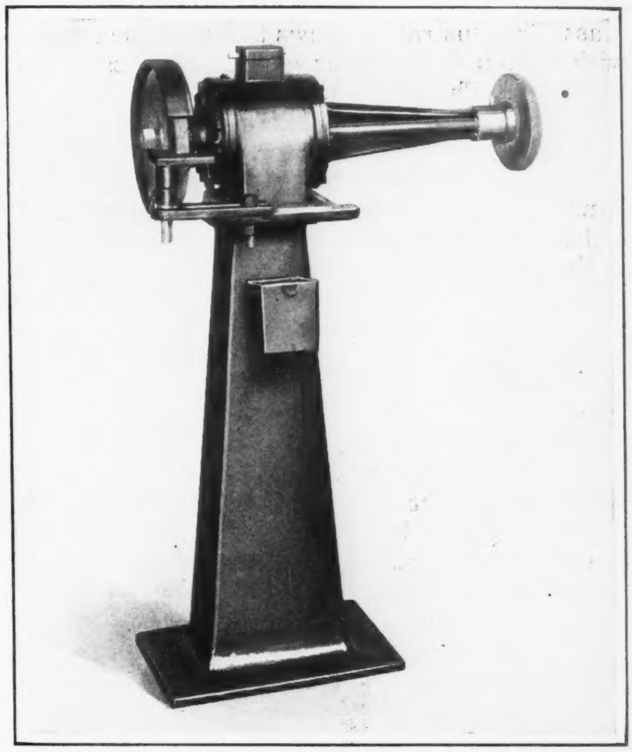


Fig. 2. Combination Grinder and Buffer

shaft runs in ball bearings that are encased in dust-proof chambers.

The wheel guards are of the hinged-door type, and have connections for an exhaust system. The guards are equipped with a spark-breaker and with an adjustable wired-glass eye-shield. The 3-horsepower grinder is provided with wheels either 12 or 14 inches in diameter by 2 inches wide. The 5-horsepower machine is furnished with wheels 18 inches in diameter by 3 inches wide.

Fig. 2 shows a combination grinder and buffer that is built in four sizes ranging up to 3 horsepower. The shaft of this machine is provided with three ball bearings. A quick make-and-break switch is located on top of the motor housing within easy reach of the operator. This machine is built for either alternating or direct current. The bench grinder illustrated in February MACHINERY may be supplied with a pedestal of the same design as this combination grinder and buffer.

An angle-plate parallel grinder, especially adapted for roll and general grinding in a lathe or surface grinding on a planer or boring mill, is shown in Fig. 3. The angle-plate is designed to be bolted to the compound rest of a lathe and to the ram of a planer or boring mill. The armature shaft of this device runs in phosphor-bronze split tapered bearings which are adjustable for wear. This grinder is manufactured in 1/4-, 1/2-, 1-, 2- and 3-horsepower sizes. The motor can be supplied for alternating or direct current.

A grinder intended for suspension from overhead is illustrated in Fig. 4. It is especially suitable for surfacing rough castings and cleaning castings of all kinds. Canvas wheels can be provided for polishing or hand-buffing operations. This grinder is made in five sizes, of 1/4-, 1/2-, 1-, 2- and 3-horsepower capacity. Three ball bearings are furnished for the armature shaft. All the machines described have spindles of nickel steel.

BLANCHARD VERTICAL SURFACE GRINDER

Several improvements have recently been made in the No. 16 vertical surface grinder built by the Blanchard Machine Co., 64 State St., Cambridge,

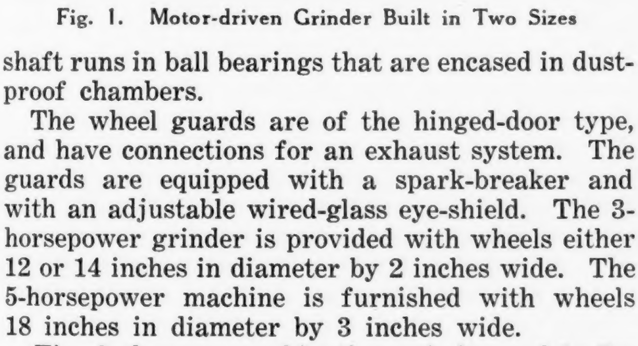


Fig. 3. Grinder for Lathe, Planer, or Boring Mill Use

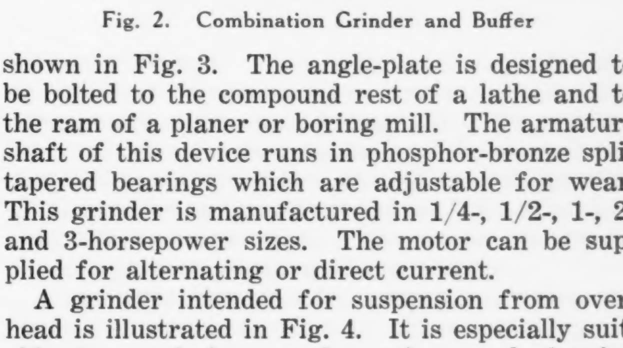
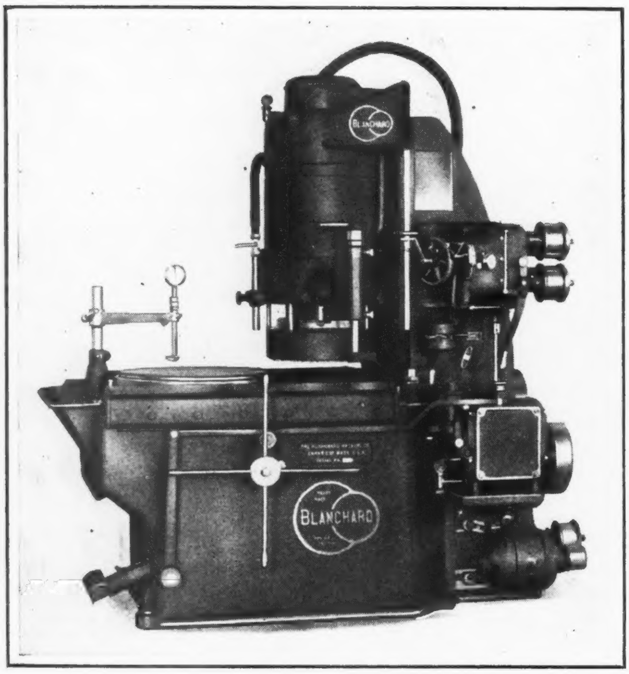


Fig. 4. Grinder for Cleaning and Surfacing Castings

Mass. The illustration shows this machine equipped with a 26-inch magnetic chuck and a caliper attachment. The improved machine has a new base with a larger water capacity than the previous base and with a longer bearing on the floor, although the over-all length has been increased only 2 inches. The new base holds over 100 gallons of coolant, as compared with the 62-gallon capacity of the old base. This additional capacity permits of keeping the work and the machine cooler in heavy grinding operations.

The treadle shaft is now neatly housed in the left-hand end of the base. The other end of the base is carried straight down to the floor under the column instead of being under-cut. These changes of outline improve the appearance of the machine and distribute the weight over a larger floor area without appreciably increasing the space occupied. The motor connections, formerly located in a box on the back of the base, are now inside the column, but are readily accessible.



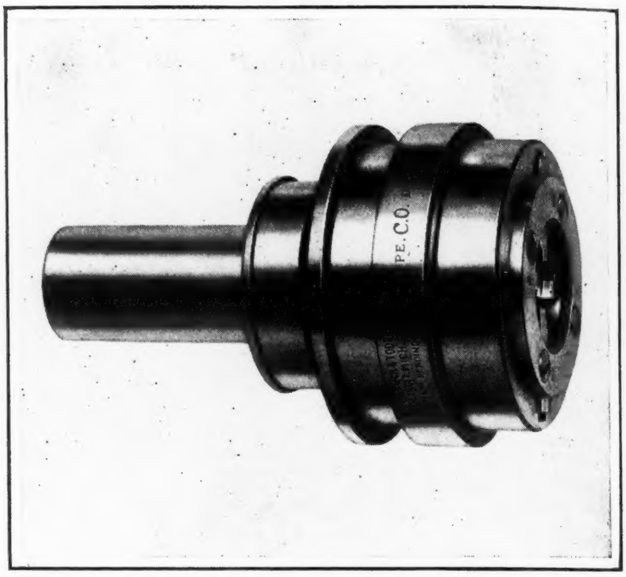
Blanchard Surface Grinder of Improved Design

Except for the improvements mentioned, the machine is similar to the design described in June, 1926, MACHINERY.

MURCHEY SELF-OPENING DIE-HEAD

A revolving type CO die-head, designed for use in any machine in which the die-head is revolved, has been placed on the market by the Murchey Machine & Tool Co., 34 Porter St., Detroit, Mich. This die-head has a shorter body than previous designs, and is arranged with a collar trip that does not increase the diameter. The principal feature is the collar trip, as it adapts the die-head to shoulder threading. It also insures a precise length of thread, due to the fact that the die-head opens instantaneously at any predetermined point.

All parts of this revolving die-head are hardened and ground. The adjusting nut is always in full view of the operator, and is readily accessible. Another feature claimed is that the action of the die-head is always positive and uniform. The chasers may be quickly removed and replaced without taking off the cap and without taking the die-head out of the spindle. The chasers, as well as most other parts of this die-head, are interchangeable with the parts of the type O series of die-heads.

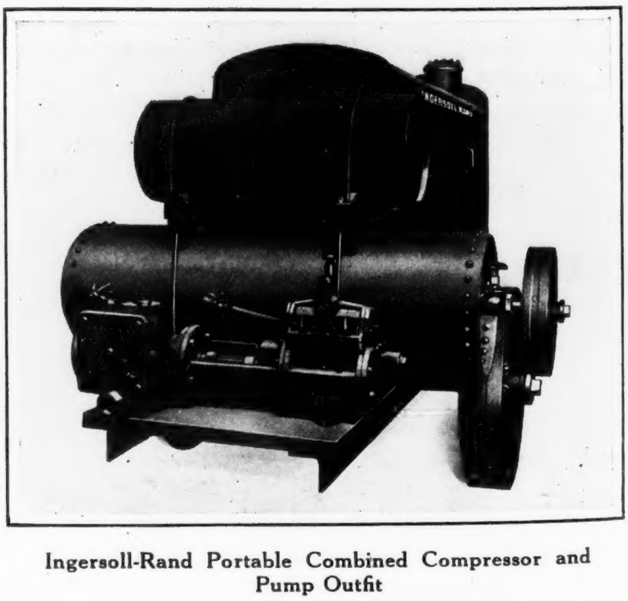


Murchey Revolving Self-opening Die-head

One-half of the fixture is eliminated with this new die-head, as a closing fixture only is needed, there being no outside trip. The die-head will be made in 7/16-, 9/16-, 1-, 1 1/4-, and 1 1/2-inch sizes. Opening and closing attachments for most types of automatics are carried in stock and, when not in stock, can be easily made up for other types of machines.

INGERSOLL-RAND COMPRESSOR-PUMP OUTFIT

A portable combined air compressor and water pump outfit is being introduced to the trade by the Ingersoll-Rand Co., 11 Broadway, New York City. This equipment consists of a standard type 20 gasoline-engine-driven portable compressor and a Cameron air-driven pump. The compressor, in addition to supplying air for the pump, will run such air tools as "Jackhamer" rock drills, portable



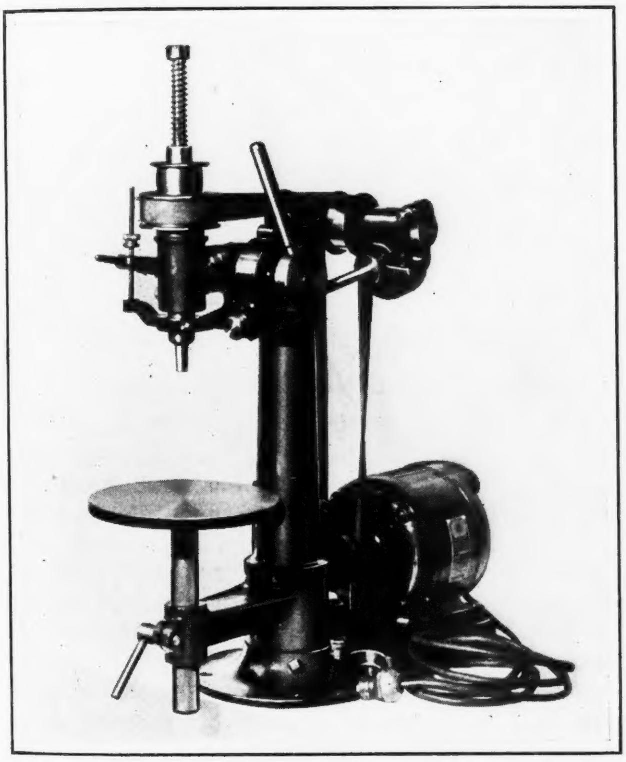
Ingersoll-Rand Portable Combined Compressor and Pump Outfit

hoists, drill steel sharpeners, etc. The outfit can be easily moved from place to place as needed.

The pump is positive in action, starting up as soon as the air is turned on, and requires no priming. It can be regulated to any desired capacity within its rating by adjusting the amount of air admitted. By mounting the air-driven pump with the compressor, the gas or oil engine formerly used to drive the pump is eliminated. This outfit is made in several sizes, and the pump can be furnished alone, together with all parts necessary for attaching it to any Ingersoll-Rand portable outfit now in the field.

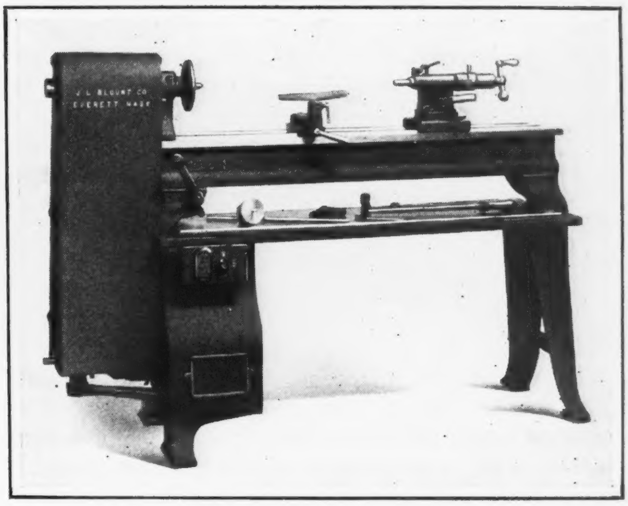
BURKE AUTOMATIC BENCH DRILLING MACHINE

A 10-inch sensitive bench drilling machine equipped with an automatic feed is being placed on the market by the Burke Machine Tool Co., 516 Sandusky St., Conneaut, Ohio. This machine has a capacity for drills up to 3/8 inch, and is driven by a 1/3-horsepower motor. The automatic feed can be tripped at any point, and the spindle is then automatically returned to its highest position. The automatic feed does not prevent the use of the regular hand feed. Worm-gearing is employed in the feed mechanism. The worm-gears run in a bath of oil, and the worm-shafts are equipped with ball bearings.



Burke Bench Drilling Machine with Automatic Feed

The spindle extends through a large bearing on which the top cone is mounted, and the spindle thrust is taken by a ball bearing. There is no pressure exerted on the spindle by the driving belt. Some of the important specifications of the machine are as follows: Diameter of table, 8 inches; greatest distance from nose of spindle to table, 9 3/4 inches; vertical movement of spindle, 2 1/2 inches; vertical movement of table, 7 inches; and weight of machine, about 95 pounds.



Blount Improved Speed Lathe

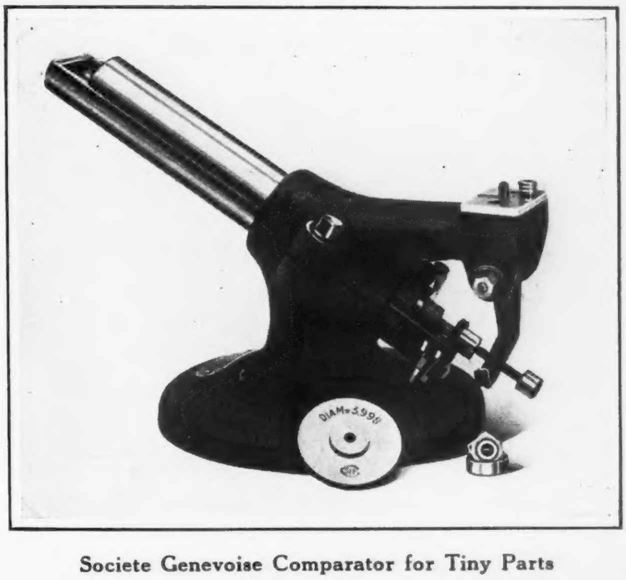
BLOUNT MOTOR-DRIVEN SPEED LATHE

The motor-driven speed lathe built by the J. G. Blount Co., Everett, Mass., has recently been redesigned to obtain greater ease of operation and maximum safety for the operator. One of the features consists of a steel guard, which fully encloses the headstock end of the lathe, the machine being belt-driven from a motor mounted on an adjustable plate within a cabinet type of headstock leg.

Speed variation has been facilitated by the addition of a hand-operated belt-shifting device, which does not decrease the belt tension. As a result, tearing and slipping of the belt are said to be eliminated. The lathe can be furnished with the headstock spindle mounted in either ring-oiling bronze bearings or heavy-duty ball bearings, depending upon the type of service for which the tool is intended. Except for the improvements mentioned, the design of the lathe remains the same, permitting the fitting of the various extra attachments.

SOCIETE GENEVOISE COMPARATOR SUPPORT

A test comparator support which makes use of a comparator tube or indicator having a knife-edge multiplication system has been added to the



Societe Genevoise Comparator for Tiny Parts

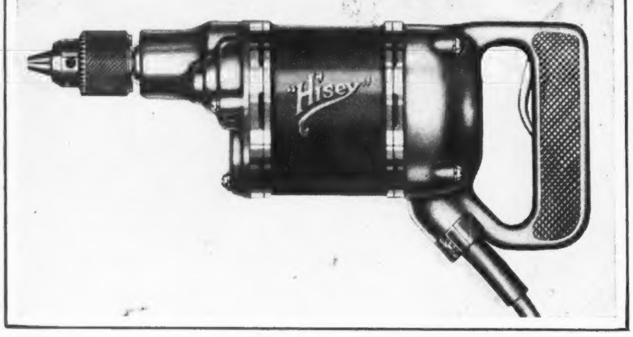
line of similar supports made by the Société Genevoise d'Instruments de Physique, Geneva, Switzerland, which are sold in the United States by the R. Y. Ferner Co., Investment Bldg., Washington, D. C. This new support is intended for checking the internal diameter of very small rings ranging from 4 to 6 millimeters (0.16 to 0.24 inch) in internal diameter. It was developed for measuring small ball bearings, but with slight modifications, the measurement of larger rings can be accomplished. The instrument can be furnished to read in either millimeters or inches.

The support includes a small rectangular table on which the work is placed for checking. Projecting from this table are a movable and a fixed contact point, the former fitting within a slot in the latter to give both sufficient strength for taking measurements of small holes. The movable contact point is shaped to make proper contact within holes ranging from 1 millimeter (0.0394 inch) above and below the nominal capacity of the device. This contact point is at one end of a lever arm, at the opposite end of which there is an adjustable contact point that bears against the plunger of the test comparator tube. The test comparator tube is adjusted to the zero reading with respect to a standard gage. The rings are then checked by substituting them for this gage. The tube is mounted obliquely so that it can be easily read. Tubes can be supplied to read to 0.001 millimeter, 0.0001 inch, or 0.00005 inch per division.

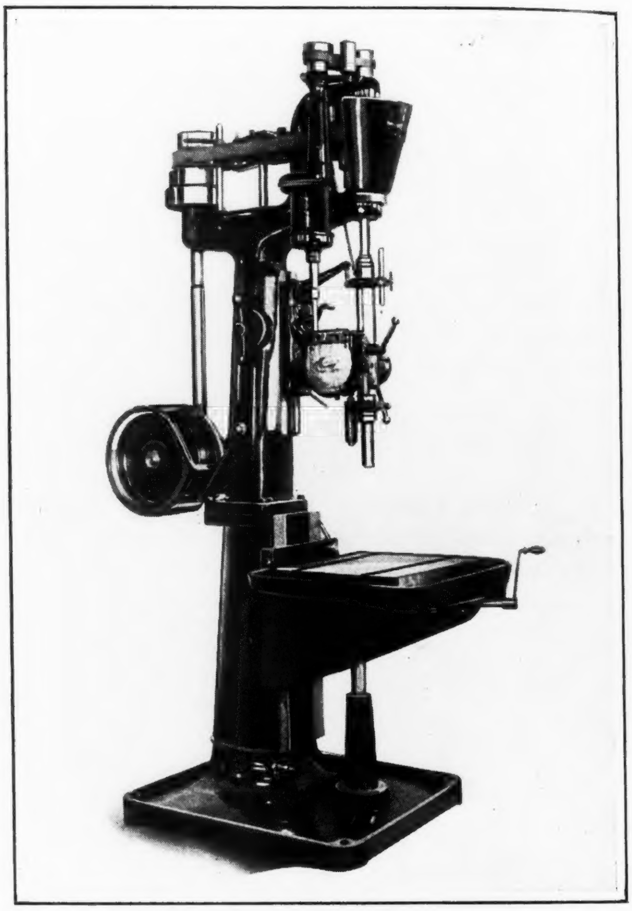
HISEY 1/4-INCH UNIVERSAL DRILL

The latest addition to the line of portable electric tools manufactured by the Hisey-Wolf Machine Co., Cincinnati, Ohio, is the standard-duty 1/4-inch universal drill here illustrated. This drill is driven by a standard Hisey motor equipped with ball bearings. The ball bearings are fitted in a way to eliminate slip and creeping action. The gear on the armature shaft is removable.

A Jacobs chuck is fitted to the hardened and ground tapered spindle, and the spindle is automatically lubricated through the gear-case. Brush-holders with an adjustable spring tension are mounted as a separate unit on a bakelite yoke. This feature permits brush adjustment when necessary. The end handle cover is independent of the motor and motor bearings, relieving them of all strain. The switch mounted in the grip handle is of the automatic quick-release type. This drill weighs 6 1/2 pounds.



Hisey 1/4-inch Portable Electric Drill



Edlund Drilling Machine of New Design

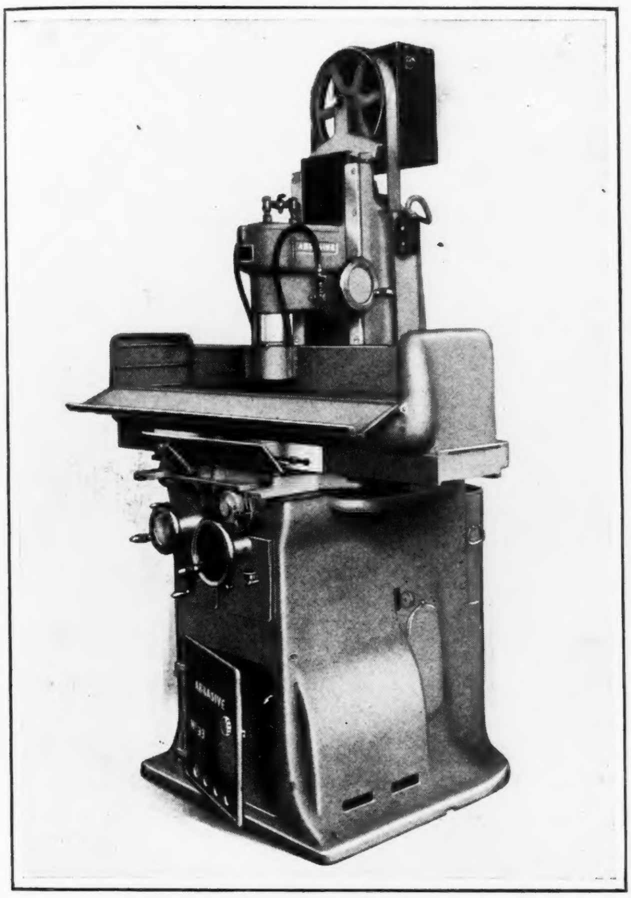
EDLUND DRILLING MACHINE

A 24-inch production type drilling machine equipped with ball bearings has recently been placed on the market by the Edlund Machinery Co., Inc., Cortland, N. Y. This machine has a capacity for drilling 1 1/4-inch holes in steel. The main drive belt is guarded by means of a casting that also provides a bracket for the belt shifter. The driving pulley is 12 inches in diameter, and has a face width of 3 1/8 inches.

Power is delivered from the pulley shaft through a pair of hardened alloy-steel spiral bevel gears. The drive from the rear cone pulley to the spindle cone pulley is through a straight endless belt, which is also guarded, as shown in the illustration. Power is delivered to the spindle through a four-spline broached sleeve.

The spindle sleeve has the feed rack cut into a flat milled on the back. Ball thrust bearings, which are provided at each end of the spindle sleeve, may be adjusted for wear. Four speed changes of the spindle are obtainable, the changes being accomplished by a half turn of a handle which may be reached from the operating position. A rack and pinion assist in raising and lowering the sliding arm.

Nine ball bearings are incorporated in each one-spindle machine. A coolant tank is cast inside the base, whether the machine is equipped with a pump or not. The machine is made in styles having from one to four spindles and with or without a power feed. The power feed is of a tooth-clutch type, having positive relief. Three feeds of 0.008, 0.011, and 0.015 inch per spindle revolution are furnished.



Improved Surface Grinding Machine Built by the Abrasive Machine Tool Co.

ABRASIVE SURFACE GRINDING MACHINE

There has recently been placed on the market an improved model of the small sensitive vertical-spindle surface grinding machine built for a number of years by the Abrasive Machine Tool Co., East Providence, R. I. This machine is intended not only for tool-room use, but also for handling a wide variety of production work. Pilot dies can be conveniently ground, as the cupped wheel of the machine easily passes between the pilots. One of the important improvements is that the height from the table to the floor has been decreased 2 inches to facilitate loading. Another feature is that the automatic travel of the vertical wheel-head has been increased to 12 inches.

The machine may be equipped with a counter-shaft drive or a direct-connected motor drive. With a motor drive, the motor is located in the frame, and the automatic switch and push-button control, together with all wiring, are fully enclosed. More motor space and belt clearance are provided than formerly. The sediment tank is now placed in back of the machine instead of on one side. It is readily detachable for cleaning. The coolant system has been completely redesigned with a view to efficient and convenient operation.

The longitudinal travel of the table is automatic in either direction, adjustable dogs being provided for reversing at any desired point. Provision is made for moving the table by hand beyond reversing points without changing the position of the dogs. The speed of the table is 12 feet per minute for roughing operations, and 5 feet per minute for finishing operations. Transverse adjustment of the table is accomplished by hand to locate the work relative to the grinding wheel. The net weight of the countershaft-driven machine is about 2400 pounds.

KEARNEY & TRECKER TIMKEN-BEARING SPINDLES

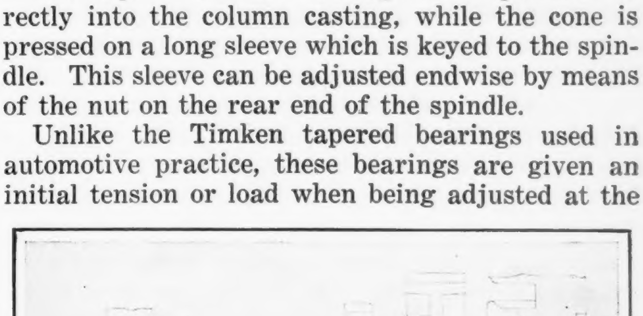
Following several years of experiment and research, which included the constant operation since October, 1921, of a milling machine in which the main spindle was equipped with Timken tapered roller bearings, the Kearney & Trecker Corporation, Milwaukee, Wis., is now regularly furnishing ten models of the larger sized Milwaukee milling machines with the main spindles mounted in these bearings. The new application is additional to the several Timken bearings used in the gear train leading up to the spindle. The advantages claimed for the use of Timken bearings over plain bearings include greater rigidity and accuracy, increased thrust capacity, permanent alignment, and longer bearing life.

In a speed test recently conducted on a main spindle running in Timken bearings, a variable-speed motor was connected directly to the shaft below the spindle, so that the drive was through gears as in normal operation. It was possible to run the spindle at a speed as high as 2600 revolutions per minute continuously for eight hours. For testing the thrust capacity, a 1 9/64-inch high-speed drill was mounted in the spindle, and by using the cross-feed table travel, was fed into S.A.E. 1020 steel at the rate of 9 inches per minute.

From the illustration, it will be seen that the cone or inner race of the large roller bearing at the front of the spindle is pressed solidly on the spindle and that the cup or outer race is pressed directly into the metal of the column front. Lubricating oil flows constantly in at the rear of the bearing, is passed through by the action of the bearing, and is returned to the column from the pocket at the front. Oil slingers prevent the escape of the lubricating oil and the entrance of cutting compound into the bearing.

The cup of the rear bearing is also pressed directly into the column casting, while the cone is pressed on a long sleeve which is keyed to the spindle. This sleeve can be adjusted endwise by means of the nut on the rear end of the spindle.

Unlike the Timken tapered bearings used in automotive practice, these bearings are given an initial tension or load when being adjusted at the

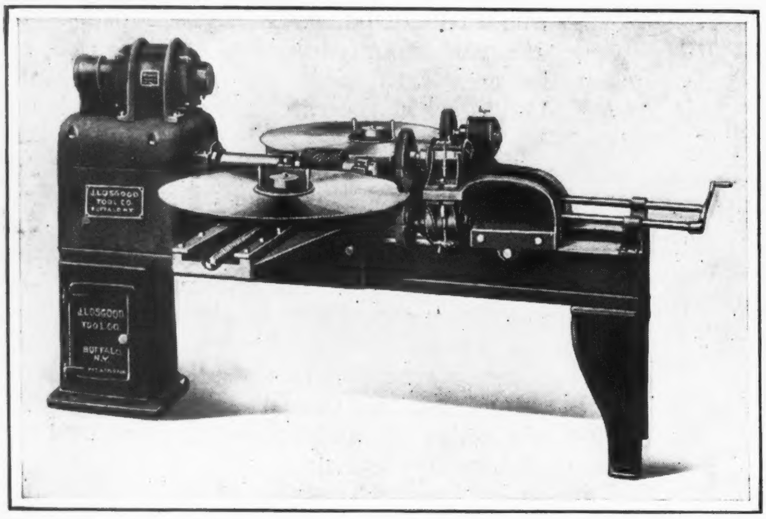


Milwaukee Milling Machine Spindle Equipped with Timken Bearings

factory, thus insuring efficient operation of the spindle without further adjustment for a long period of time. In running the spindle, the bearings become slightly tighter at high speeds and do not loosen as might be expected. This tightening, however, is never enough to load the bearings excessively, when the spindle is first properly adjusted at room temperature.

OSGOOD DUPLEX COMBINATION MACHINE

A duplex machine designed primarily for cutting the teeth of cold saws and grinding burrs from the teeth at the same time has recently been developed by the J. L. Osgood Tool Co., 43-45 Pearl St., Buffalo, N. Y. This machine is also intended for knurling, worm-gear hobbing, and similar operations. It has a capacity for saws from 20 to 90 inches in diameter, and from 1/4 to 5/8 inch thick. Two saws of different diameters and thicknesses can be cut and ground at the same time as readily as two saws of the same diameter and thickness, the front and rear saw-spindle and grinder heads being set independently of each other. The machine is particularly suitable for use in steel mills and wherever structural shapes, plates, etc., are worked on.



Osgood Machine for Cutting and Burr-grinding Saw Teeth

A high-speed steel cutter 6 inches in diameter and 6 inches in face width is employed. The saw carriage is adjustable horizontally so that the full width of the cutter can be used. The machine cuts the saw teeth rapidly and with only two or three passes. While the teeth are being cut, motor-driven emery wheels, one above and one below each saw, grind off the steel burrs raised by pressure during the sawing of steel or by the cutter in cutting the teeth.

The machine is regularly equipped with a motor running at 1200 revolutions per minute, but a single-pulley belt drive can be furnished. The weight of the machine is approximately 4500 pounds.

WALTHAM MAGAZINE-FED PINION CUTTING MACHINE

The 1 1/2-inch automatic pinion and gear cutting machine built by the Waltham Machine Works, Newton St., Waltham, Mass., which was described in May, 1925, MACHINERY, is now equipped with a magazine feed as illustrated. This feed saves considerable time in cutting solid or hollow pinions in large quantities. In operating the machine, all the attendant needs to do is to place the work blanks in the track of the magazine, the machine operating continuously.

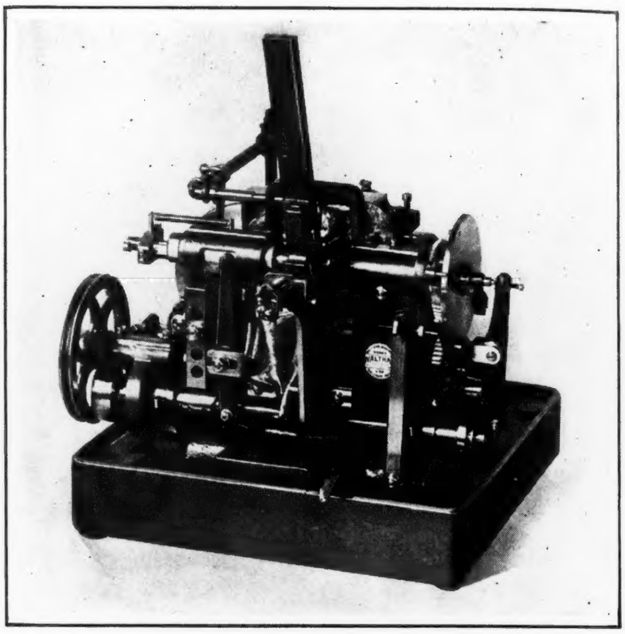


Fig. 1. Waltham Automatic Pinion and Gear Cutting Machine with Magazine Feed

When a blank has been completely cut, by using either a single cutter or two or three cutters, the magazine operating mechanism stops the motion of the main camshaft, withdraws the tailstock spindle, ejects the cut pinion, brings a blank from the magazine into position, grips the blank, and then starts the main camshaft again.

All these steps are performed in less than one second, and hence there is a gain of time on each pinion nearly equal to that required to change the work in a hand-fed machine. In some instances, the time required for changing work in a hand-fed machine is almost as long as the operation of cutting. One operator can care for a larger number of magazine-fed machines than hand-fed machines. Fig. 2 shows drawings of typical pieces that can be accommodated by the magazine feed. These drawings are reproduced actual size.

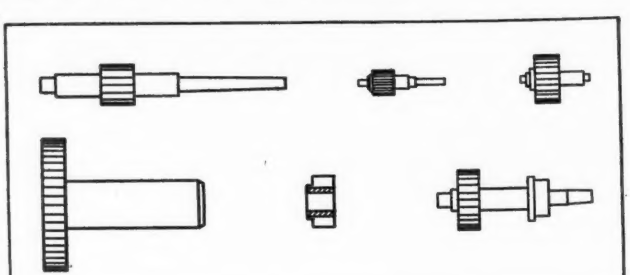


Fig. 2. Typical Examples of Work Handled by Magazine Feed

BUFFALO UNIVERSAL IRON-WORKER

A No. 0 universal iron-worker which constitutes a combined punch, shear, and bar cutter, has recently been added to the line of machines built by the Buffalo Forge Co., 144 Mortimer St., Buffalo, N. Y. This No. 0 machine is a smaller size of the Nos. 1/2 and 1 1/2 universal iron-workers built by the same company. The No. 1/2 machine was described in October, 1924, and June, 1926, MACHINERY.

The No. 0 machine is operated at the rate of 35 strokes per minute, and is intended for rapidly working large quantities of comparatively light steel stock. It is built with an "Armor-Plate" rolled-steel frame, and is equipped with crucible-steel shear blades having four interchangeable cutting edges. Five-piece bar cutter knives make sharpening and replacement easy. These knives can be furnished for special shapes. A triple punching attachment can be easily inserted in the machine.

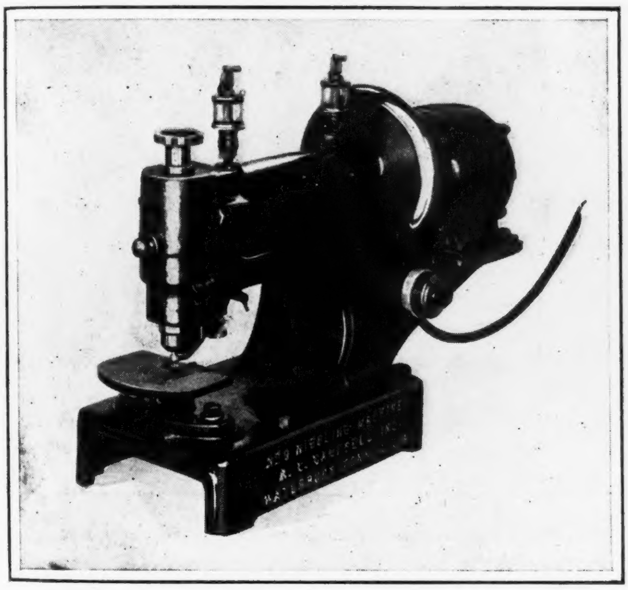


Fig. 1. Campbell Bench Type Nibbling Machine

This machine may also be equipped with a notcher for angle, tee, channel, and zee shapes, I-beams, plates, flat bars, etc. The notcher does not interfere with the use of the regular punch, shear, and bar cutter. The machine has a stroke of 7/8 inch, a 10-inch throat and, when equipped with a belt drive, weighs 2200 pounds. A motor-driven machine weighs approximately 2300 pounds.

NUTTALL REDUCTION GEAR UNITS

The principal feature of a new series of reduction units developed by the R. D. Nuttall Co., McCandless and Harrison Ave., Pittsburg, Pa., is the use of 7 1/2-degree helical gears and Timken tapered roller bearings. There are six units in this series, which is known as the "MS and MR," and these units completely cover a range of from 150 to 2000 horsepower. The units are designed for transmitting heavy loads at relatively high speeds, as required in main and auxiliary drives of steel mills and in driving crushers, hoists, pumps, and other heavy equipment.

The units are equipped with either 7 1/2-degree single helical or herringbone gears, which are treated or untreated, depending upon the application. The units may be furnished with sleeve bearings instead of Timken bearings. Bearings of one type can be replaced conveniently with bearings of the other type, because the housings are identical for both types. In the case of such changes, however, new shafts must be provided.

The gears are totally enclosed in a fabricated cast-iron case, the bottom of which serves as a reservoir for lubricant. The gears run in a bath of oil, while the bearings are lubricated by means of a positive splash system. The same lubricant is used for both gears and bearings.

CAMPBELL NIBBLING MACHINES

Two new nibbling machines have recently been added to the line built by Andrew C. Campbell, Inc., Bridgeport, Conn. One of these, the No. 0,

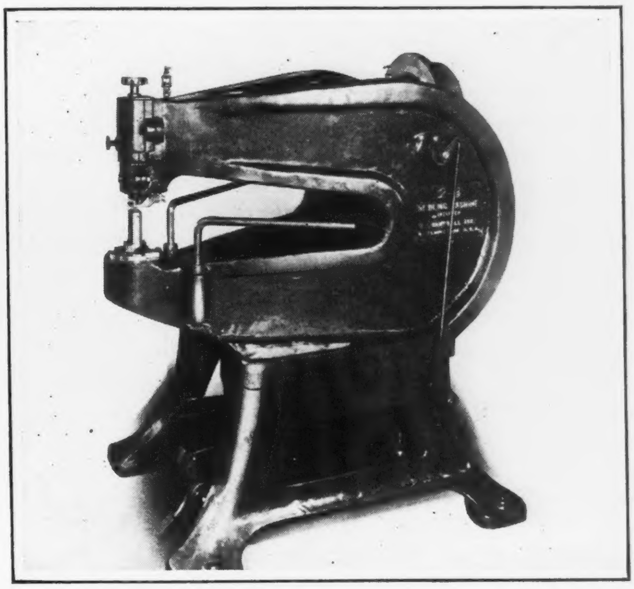


Fig. 2. Nibbling Machine for Material up to 3/8 Inch Thick

is a bench type and is intended for cutting sheet material up to No. 14 gage. It will cut material at the rate of 60 inches per minute. As shown in Fig. 1, this machine is furnished with a direct motor drive. When desired, it can be furnished with a stand for floor use.

The second of the new machines—the No. 2-B—has a deep throat and is intended for cutting sheet material up to 3/8 inch thick. This machine is shown in Fig. 2. It can be equipped for either a belt or motor drive, the cutting speed depending upon the pulley speed. The operating principle of both machines is the same as that of the other nibbling machines built by this company, which were described in the November, 1923, and the November, 1922, numbers of MACHINERY.

GRAND RAPIDS TAP AND DRILL GRINDER

Four sizes of a combination tap and drill grinder are being introduced to the trade by the Gallmeyer & Livingston Co., 344 Straight Ave., S.W., Grand Rapids, Mich. The four sizes accommodate drills

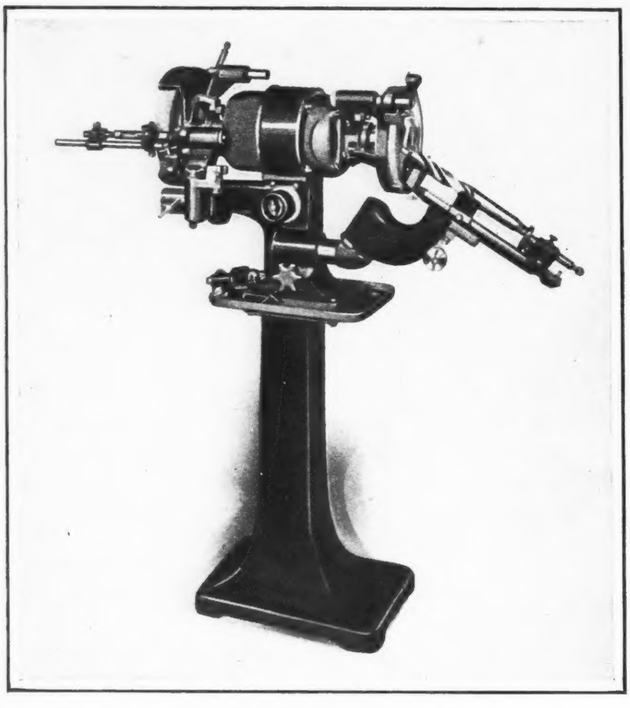
from No. 52 to 2 1/2 inches in diameter, and taps from No. 6 to 3 inches in diameter. While the illustration shows the machine equipped with a direct motor drive, a belt drive can also be provided.

The only adjustment necessary in grinding drills is to set the tailstock to suit the length of the drills. Adjustments of the lip rest are not required, and neither is it necessary to make adjustments for grinding drills of different diameters or for changing from straight-shank to taper-shank drills.

The drill is held in the holder with one hand, and the tailstock brought up into position and clamped with the other hand. The drill-holder is automatically placed in the correct relation to the grinding wheel. A patented stop, working in conjunction with the diamond truing device, makes it impossible for the holder to be brought close enough to damage the lip rest.

The mechanism used in grinding taps provides for grinding the taper at the end of the tap and the clearance in back of the cutting edge thus formed. This taper may be long, as on nut taps, short, as on plug taps, or almost absent, as on bottoming taps. Every flute is given the same angle of taper and just enough clearance to make it cut freely but not enough to weaken the cutting edge too much. A diamond truing device and diamond are provided for each wheel, so that the diamond is always in proper position for use.

A repulsion induction type of motor is built into the machine head. The armature shaft carries the grinding wheels. Special motor end-bells which carry heavy ring-oiled phosphor-bronze bearings replace those usually supplied with the motor.

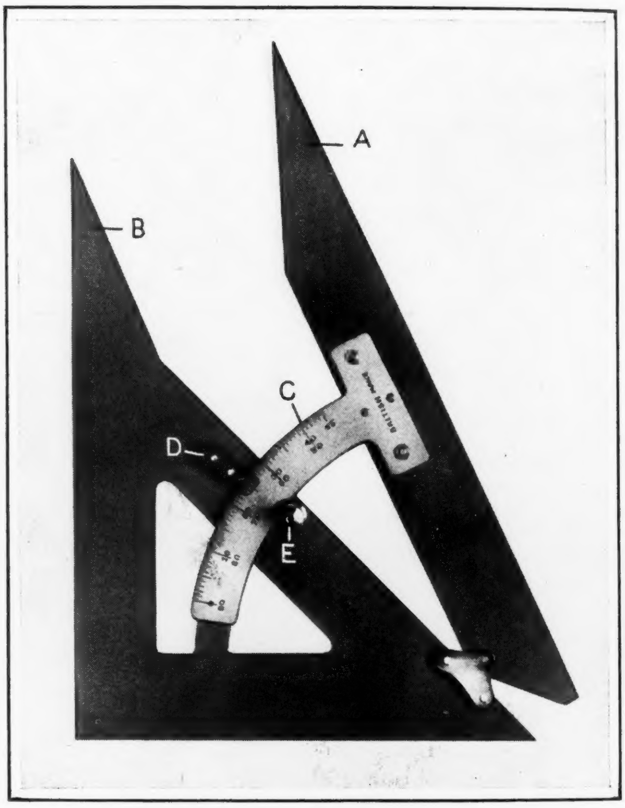


Grand Rapids Combination Tap and Drill Grinder

"FACILA" PROTRACTOR TRIANGLE

An adjustable triangle designed to facilitate drawing lines at different angles has recently been placed on the market by E. S. Brown, 247 W. Genesee St., Auburn, N. Y. As may be seen from the illustration, the device has a hinged arm *A* known as the "swinging right angle" which may be quickly set in any position relative to part *B* by using the protractor scale *C* in conjunction with an index-line on piece *D*. Scale *C* can then be locked to the principal part *B* by tightening nut *E*. The protractor scale has 1/2-degree graduations.

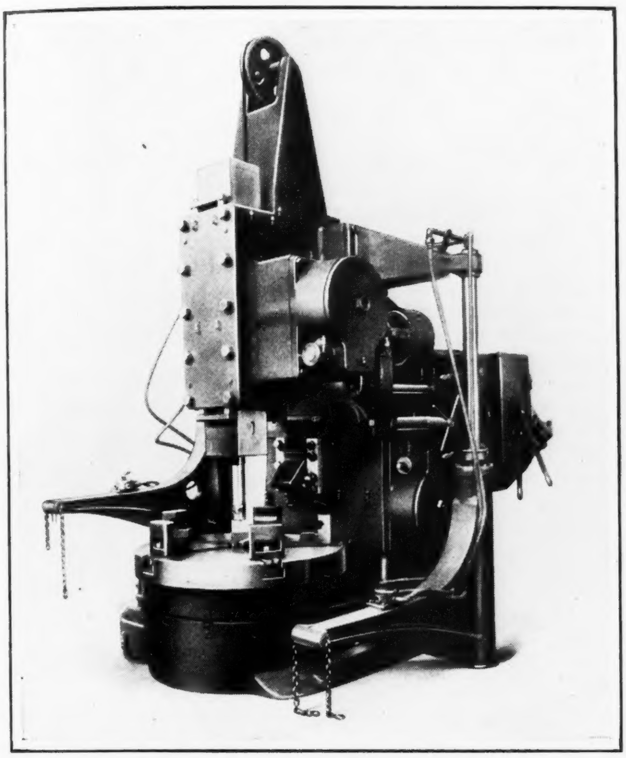
The two inner edges of part *B* form angles of approximately 45 and 22 1/2 degrees with the bottom and left-hand edges, respectively. They are handy in making sketches. When the hinged arm is pushed against part *B*, the outer edge of the hinged arm is inclined at an angle of 45 degrees relative to the two outer edges of part *B*. Parts *A* and *B* are made of transparent celluloid, and the protractor scale of ivory-grained celluloid. Nickel-plated fittings are used for attaching the different pieces. Right- and left-hand sides of symmetrical drawings can be produced without resetting this device. It is made in two sizes having a 7- and 10-inch hinged arm, respectively.



Draftsman's Triangle with Hinged Arm

BETTS CAR-WHEEL BORING AND FACING MILL

An extra heavy car-wheel boring and facing machine, intended for rough-boring and facing the hubs of rolled- or cast-steel car wheels on a manufacturing basis, has been brought out by the Betts Works of the Consolidated Machine Tool Corporation of America, Rochester, N. Y. Wheels from 20 to 42 inches in diameter can be accommodated. The chuck is 52 inches in diameter, is fully automatic, and is equipped with five heavy jaws designed to chuck wheels with the flange either up or down. This chuck is driven by a spur gear and pinion of wide face and coarse pitch.



Betts Boring and Facing Mill for Car Wheels

The main drive to the machine is through a 50-horsepower variable-speed motor equipped with an automatic push-button control and a dynamic braking mechanism for stopping the machine quickly. The vertical boring spindle is of heavy rectangular section, and is provided with square guides and shoes for taking up wear. It is counterweighted by means of a weight which enters a chamber in the frame as the spindle is elevated.

The horizontal facing spindle is also of heavy rectangular section, and is provided with a sliding support in a square guide, so that the tool is always backed up rigidly close to the cut. The tool-holder has a hand adjustment for tool setting. Both the boring and facing spindles are provided with a range of power feeds through sliding steel gears that are operated by means of shifter levers. There is also a power rapid traverse for the two spindles, which is obtained through a separate motor, and is so arranged that a feed may be used on either spindle while the power rapid traverse is being used on the other.

Two pneumatic hoists are furnished for lifting wheels to the chuck and lowering them, respectively. With this arrangement, the wheels may be loaded and unloaded from either side of the machine. The hoists may be quickly manipulated, as both of them will swing to the center of the table.

* * *

Nearly one-half of the total imports of industrial machinery into Great Britain come from the United States. In 1925 the total value of the imports amounted to $35,420,000, of which $17,365,000 came from the United States. Imports of machine tools from all countries amounted to approximately $3,770,000. Of this the United States supplied approximately 60 per cent, the imports of machine tools from the United States being valued at $2,300,000.

MACHINE TOOL TRADE WITH SPAIN

The machine tool imports of Spain continue to decline, according to a recent issue of *Commerce Reports,* although the experience of Germany in exporting heavy machine tools to Spain is an exception to this general decline. The Spanish imports of heavy German machinery last year, however, consisted of equipment for large steel and shipbuilding plants contracted for two years ago by German capital. Special customs exemptions were given by the Spanish Government, and part of the equipment imported was second-hand. The machines were of the heavier type, weighing 10 tons apiece or more.

The general decline in Spanish imports of machine tools is the result of a serious crisis in the Spanish metal-working industry. In 1922, the Spanish customs tariff was increased on all classes of machine tools to favor one or two firms who claimed to be able to establish a national machine tool industry. The promised industry has not yet been satisfactorily established, and Spanish users of machine tools must bear the brunt of high machine tool costs. Therefore, the only extensive purchases being made are by factories who are able to obtain certain exemptions under the law for the protection of national industry, including three leading steel mills working on government railway business. Among others able to buy are a few factories manufacturing agricultural implements which are themselves heavily protected by the tariff, and two new plants for the manufacture of telephone equipment.

Purchases of machine tools in Spain from 1919 to 1922 were abnormal and cannot form a standard for comparison with the present. These years were a period of industrial enthusiasm, when large investments were made in new factories. This era is now over, and it is realized that Spain is not at present in a position to manufacture either as well or as cheaply as the old established industrial nations. Increased tariff protection is continually solicited by the industries, but in some instances, this has tended to create a stagnation in the foreign trade, without any corresponding encouragement of the domestic industries—an experience that has been shared lately by several European countries.

* * *

IMPROVED BALLS FOR BRINELL TEST

At the winter sectional meeting of the American Society for Steel Treating at Washington, D. C., January 20 and 21, G. W. Quick, assistant metallurgist, and L. Jordan, chemist of the Bureau of Standards, Washington, D. C., read a paper on the use of an iron-carbon-vanadium alloy for balls for making Brinell tests. When these tests are applied to steels of such hardness as will cause ordinary Brinell balls to deform, the alloy recommended for use in testing consists of 2.9 per cent carbon and 13 per cent vanadium, the remainder being iron. Balls made from this material, and heat-treated, were found, when tested on steels of approximately 700 Brinell hardness, to flatten only one-fifth as much as the ordinary balls used for the Brinell hardness test, and only one-half as much as the special "Hultgren" balls used for this purpose.

MACHINE TOOL BUILDERS' EXPOSITION

It has been announced that the entire available exhibition area of the National Machine Tool Builders' Exposition to be held in Cleveland, September 19 to 23, inclusive, has been reserved, and that in addition there is a waiting list of firms who would like to obtain display space if it were available.

The exposition will be held in and will occupy all of the new West Annex of the Public Auditorium in Cleveland. The building contains more than 100,000 square feet of floor space, practically unobstructed, and was built to meet exacting exposition specifications. Reservation of the entire area of this building was made before even a tentative floor diagram was available for prospective exhibitors.

The association is making a strenuous effort to obtain additional exhibition space so as to accommodate the firms now on the waiting list and others whose applications for space may be received at a later date. It is believed that within a short time a plan may be worked out for the accommodation of from 50 to 100 additional exhibitors. At present about 150 firms are included in the list of exhibitors, which is as follows:

Abrasive Machine Tool Co., East Providence, R. I.
Acme Machinery Co., Cleveland, Ohio
Acme Machine Tool Co., Cincinnati, Ohio
Chas. G. Allen & Co., Barre, Mass.
American Machinist, New York City
American Tool Works Co., Cincinnati, Ohio
Associated Machine Tool Dealers, Cleveland, Ohio
Avey Drilling Machine Co., Cincinnati, Ohio
Badger Tool Co., Beloit, Wis.
Baker Bros., Inc., Toledo, Ohio
Barber-Colman Co., Rockford, Ill.
W. F. & John Barnes Co., Rockford, Ill.
Barnes Drill Co., Rockford, Ill.
John Bath & Co., Inc., Worcester, Mass.
Chas. H. Besly & Co., Chicago, Ill.
The Blanchard Machine Co., Cambridge "A," Mass.
J. G. Blount Co., Everett, Mass.
Bowen Products Corporation, Auburn, N. Y.
The Bradford Machine Tool Co., Cincinnati, Ohio
Bridgeport Safety Emery Wheel Co., Inc., Bridgeport, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bryant Chucking Grinder Co., Springfield, Vt.
Buhr Machine Tool Co., Ann Arbor, Mich.
The Bullard Machine Tool Co., Bridgeport, Conn.
Canadian Machinery, Toronto, Canada
The Carlton Machine Tool Co., Cincinnati, Ohio
Chicago Belting Co., Chicago, Ill.
Chicago Pipethread Machine Co., Racine, Wis.
The Cincinnati Bickford Tool Co., Cincinnati, Ohio
Cincinnati Lathe & Tool Co., Cincinnati, Ohio
Cincinnati Milling Machine Co., Cincinnati, Ohio
Cincinnati Shaper Co., Cincinnati, Ohio
Cisco Machine Tool Co., Cincinnati, Ohio
Cleveland Automatic Machine Co., Cleveland, Ohio
Cleveland Planer Co., Cleveland, Ohio
Cleveland Punch & Shear Works Co., Cleveland, Ohio
Cochrane-Bly Co., Rochester, N. Y.
Columbia Machine Tool Co., Hamilton, Ohio
The Commercial Tool Co., Cleveland, Ohio
Consolidated Mach. Tool Corpn. of America, Rochester, N. Y.
Detroit Machine Tool Co., Detroit, Mich.
Diamond Machine Co., Providence, R. I.
Dreses Machine Tool Co., Cincinnati, Ohio
Eastern Machine Screw Corporation, New Haven, Conn.
Ex-Cell-O Tool & Mfg. Co., Detroit, Mich.
Fairbanks Morse & Co., Chicago, Ill.
Farrel Foundry & Machine Co., Buffalo, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
The Flather Co., Nashua, N. H.
The Foote-Burt Co., Cleveland, Ohio
Fosdick Machine Tool Co., Cincinnati, Ohio
Foster Machine Co., Elkhart, Ind.
Gairing Tool Co., Inc., Detroit, Mich.
Gallmeyer & Livingston Co., Grand Rapids, Mich.
Gardner Machine Co., Beloit, Wis.
General Electric Co., Schenectady, N. Y.
Geometric Tool Co., New Haven, Conn.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gisholt Machine Co., Madison, Wis.
Gits Bros. Mfg. Co., Chicago, Ill.
Gleason Works, Rochester, N. Y.
Goddard & Goddard Co., Detroit, Mich.
Gould & Eberhardt, Irvington, Newark, N. J.
Greenfield Tap & Die Corporation, Greenfield, Mass.
Greenlee Bros. & Co., Rockford, Ill.
Hanson-Whitney Machine Co., Hartford, Conn.
The Heald Machine Co., Greendale, Worcester, Mass.
The Hendey Machine Co., Torrington, Conn.
The High Speed Hammer Co., Inc., Rochester, N. Y.
Hisey-Wolf Machine Co., Cincinnati, Ohio
Hoefer Mfg. Co., Freeport, Ill.
Ingersoll Milling Machine Co., Rockford, Ill.
International Machine Tool Co., Indianapolis, Ind.
Iron Age, New York City
Jones & Lamson Machine Co., Springfield, Vt.
Kearney & Trecker Corporation, Milwaukee, Wis.
Keller Mechanical Engineering Corporation, Brooklyn, N.Y.
Kelly Reamer Co., Cleveland, Ohio
Kempsmith Mfg. Co., Milwaukee, Wis.
Kent Machine Co., Kent, Ohio
King Machine Tool Co., Cincinnati, Ohio
W. B. Knight Machinery Co., St. Louis, Mo.
Landis Machine Co., Inc., Waynesboro, Pa.
Landis Tool Co., Waynesboro, Pa.
The J. N. Lapointe Co., New London, Conn.
R. K. LeBlond Machine Tool Co., Cincinnati, Ohio
Lees-Bradner Co., Cleveland, Ohio
Lehmann Machine Co., St. Louis, Mo.
Leland-Gifford Co., Worcester, Mass.
The Lincoln Electric Co., Cleveland, Ohio
Lodge & Shipley Machine Tool Co., Cincinnati, Ohio
Logansport Machine Co., Logansport, Ind.
The Lucas Machine Tool Co., Cleveland, Ohio
Machine Products Co., Cleveland, Ohio
MACHINERY, New York City
McCrosky Tool Corporation, Meadville, Pa.
Michigan Tool Co., Detroit, Mich.
Micro Machine Co., Bettendorf, Iowa
Moline Tool Co., Moline, Ill.
The Monarch Machine Tool Co., Cidney, Ohio
Murchey Machine & Tool Co., Detroit, Mich.
National Acme Co., Cleveland, Ohio
The National Automatic Tool Co., Richmond, Ind.
National Machinery Co., Tiffin, Ohio
New Britain Machine Co., New Britain, Conn.
Niagara Machine & Tool Works, Buffalo, N. Y.
Niles Tool Works, Hamilton, Ohio
Norma-Hoffman Bearings Corporation, Stamford, Conn.
Norton Co., Worcester, Mass.
The Oesterlein Machine Co., Cincinnati, Ohio
The Ohio Machine Tool Co., Kenton, Ohio
The Oilgear Co., Milwaukee, Wis.
Oliver Instrument Co., Adrian, Mich.
Peerless Machine Co., Racine, Wis.
The Porter Cable Machine Co., Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Putnam Machine Co., Fitchburg, Mass.
Racine Tool & Machine Co., Racine, Wis.
Ransom Mfg. Co., Oshkosh, Wis.
Reed-Prentice Corporation, Worcester, Mass.
Rickert-Shafer Co., Erie, Pa.
Rivett Lathe & Grinder Corporation, Boston, Mass.
Rockford Drilling Machine Co., Rockford, Ill.
Rockford Machine Tool Co., Rockford, Ill.
Joseph T. Ryerson & Son, Inc., Chicago, Ill.
William Sellers & Co., Inc., Philadelphia, Pa.
The Sidney Machine Tool Co., Sidney, Ohio
S.K.F. Industries, Inc., New York
Skinner Chuck Co., New Britain, Conn.
Smith & Mills Co., Cincinnati, Ohio
Springfield Machine Tool Co., Springfield, Ohio
Standard Tool Co., Cleveland, Ohio
L. S. Starrett Co., Athol, Mass.

Sundstrand Machine Tool Co., Rockford, Ill.
The Taylor & Fenn Co., Hartford, Conn.
The Thompson Grinder Co., Springfield, Ohio
Timken Roller Bearing Co., Canton, Ohio
Torrington Co., Torrington, Conn.
Union Mfg. Co., New Britain, Conn.
Union Twist Drill Co., Athol, Mass.
Universal Boring Machine Co., Hudson, Mass.
The Van Dorn & Dutton Co., Cleveland, Ohio
Van Norman Machine Tool Co., Springfield, Mass.
Walcott Machine Co., Jackson, Mich.
O. S. Walker Co., Inc., Worcester, Mass.
The Wardwell Mfg. Co., Cleveland, Ohio
The Warner & Swasey Co., Cleveland, Ohio
Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.
J. H. Williams & Co., Buffalo, N. Y.
Williams, White & Co., Moline, Ill.
Wilmarth & Morman Co., Grand Rapids, Mich.
Wisconsin Electric Co., Racine, Wis.

* * *

OBSOLETE ANNEALING METHODS

By JAMES MC INTOSH

In the article entitled "Obsolete Annealing Methods" in December MACHINERY, page 246, it was stated that the use of containers in annealing is not considered essential. The writer believes this statement should be qualified. In the case of pickled and cold-rolled tin plate, for instance, packs of plates are laid on a platform having an edge that keeps the pack from warping, and a covering box is placed over the material to exclude air. If this were not done, the sheets would become scaly as a result of oxidation. The same condition is true in the case of steel wire that is drawn until it has become so hard that it must be annealed to permit drawing to a smaller size. The annealing in such cases must be done in a muffle or closed container, for the same reason that the tin plate sheets are so treated.

The writer was once confronted with the problem of disposing of a large lot of automobile engine piston and cylinder castings which had been shipped a considerable distance from the foundry and which could not be machined, owing to their hardness. These castings had been placed in the cellar, as it had been suggested that they would season and age there so that they would be soft enough to machine. This was, of course, impossible, and it was suggested that annealing was the only means by which the castings could be made soft enough for machining. It was found that an attempt had previously been made to anneal a set of the castings in an open furnace, with the result that the intense direct heat had warped the castings and the thin jacket walls of the cylinders had, in some cases, become melted.

In view of these experiences, the writer suggested that the castings be packed in a standard annealing box and heated in the furnace. First, a layer of fine coal ashes was placed on the bottom of the annealing box. Then the castings were placed on the ashes. After filling the intervening spaces with ashes and covering them to a sufficient depth, another layer of castings was laid down and packed in a similar manner. When the layers had been built up nearly to the top of the box, an additional layer of ashes was spread over the whole mass and the box sealed by plates. The annealing box was then placed in a furnace, brought to a red heat, and left to cool over the week-end. After annealing in this manner, the castings showed no signs of hardness or warping, and it is doubtful if they could have been effectively annealed by any other method.

Light and irregular shaped castings that are likely to be distorted when red hot by the weight of the settling contents of the annealing box should be carefully packed. When care is taken to see that each piece makes contact at as many bearing points as possible, little difficulty will be encountered from warpage. The settling process must take place during the filing of the annealing box, to prevent warpage. This settling is often accomplished by vibrating the container or annealing box. The vibrations are produced by mechanical means in the case of malleable castings that are subjected to long periods of heat-treatment, and the same methods should prove effective in the case of parts packed in annealing boxes.

This procedure is now commonly followed in the case of automobile pistons and cylinders, on the theory that internal strains in the castings can be relieved by raising their temperature to from 500 to 800 degrees F. This process can hardly be considered annealing, as it is, strictly speaking, more in the nature of "seasoning" by the acceleration method. Seasoning of castings in this manner may be rushed to the point where fracture of the jacket walls occurs. Such fractures result from the relatively thin walls coming in contact with intense heat, or the relatively thicker sections retaining the heat longer, so that the final cooling is not uniform throughout the casting.

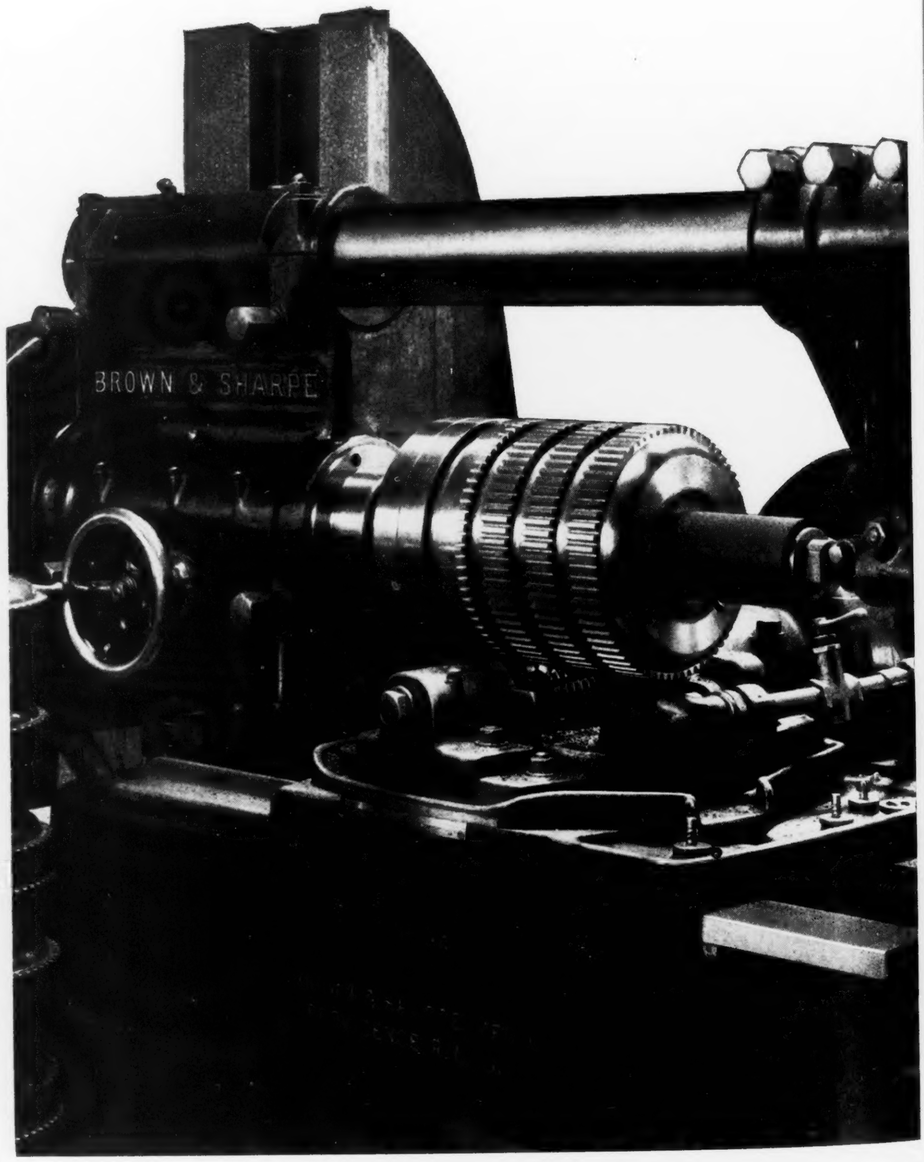
In the case of a complicated automobile engine cylinder block, the casting is subjected to all manner of strains at the foundry. Later, when assembled in an engine, it is again subjected to a great variety of stresses as a result of the unequal temperatures in various parts of the engine. When the water in the cylinder jacket does not maintain a uniform temperature from the top to the bottom of the cylinder, the bottom of the crankcase is distorted to a point where it sometimes throws the crankshaft bearings out of alignment. The operation of the engine over a long period of time, however, tends to relieve these strains, and a casting that has been used in an engine for a long period of time may be considered to be thoroughly seasoned.

* * *

CHICAGO POWER EXPOSITION

A very successful exposition of engineering and power equipment was held at the Coliseum in Chicago, February 15 to 18, inclusive. Practically all the 82,000 square feet of floor space available was occupied by the largest and most diversified exhibit of power machinery and allied equipment ever held under one roof in the Middle West. Approximately 260 companies exhibited, and the equipment on exhibit was valued at considerably more than $1,000,000. In connection with the exhibit, a technical program was presented, with the cooperation of several engineering societies, including the American Society of Mechanical Engineers. A number of excursions were made to public service and manufacturing plants in and about Chicago.

Get Better Gears—and



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BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

PROTECTIVE COATINGS FOR PATTERNS

By FREDERICK W. SALMON

This article deals with protective coatings for patterns made of wood for producing sand molds in which to cast iron and other metals. Patterns for this purpose are commonly made of soft wood such as white pine, cypress, basswood, cedar, and poplar. The more expensive patterns are made of mahogany, walnut, and other fine-grained woods. Up to a few years ago almost all the cheaper patterns were made of so-called "clear white pine," but the price of this material has become so high that the other woods named are now employed for a large class of patterns, particularly those for temporary use in making only a few castings or for special machines or repair parts.

One of the items of considerable expense in making patterns is the cost of the protective coating. Sometimes a plain wood-pattern without varnish or other coating is used, but this absorbs moisture from the damp molding sand and swells. Also, the grain often becomes rough and uneven. Then, too, an uncoated pattern frequently warps, and after being used a few times, the moisture affects the glued joints and renders the pattern unfit for further use. For these reasons, it has long been customary to coat patterns with some waterproof material.

The common practice for a long time was to use two or more coats of shellac dissolved in grain alcohol, often colored black, red, or yellow to indicate core-prints, brass parts, etc. Shellac and alcohol, however, are both high in price today and difficult to obtain. Denatured alcohol is not generally as satisfactory as straight grain alcohol, and wood alcohol is not satisfactory, besides being dangerous to have around. For these reasons, some experimenting has been done in order to find a satisfactory inexpensive coating material.

Inexpensive Coating for Temporary Patterns

Heavy black fuel oil has been used on extremely cheap and rough patterns made for the production of only one or a few castings. This oil is disagreeable to handle, often raises the grain of the wood, soon wears off, and in many cases, the sand of the mold adheres to it, requiring more slicking up of the mold. Hence this is not a very desirable material, although it is inexpensive and can be easily obtained.

Common beef tallow has also been used, both melted or hot, as well as dissolved in some cheap oil, generally with the aid of heat, and as the cheapest obtainable grade is usually bought, it often has a disagreeable odor; it is objected to in some cases because of fear of infection in cuts and slight wounds on the hands of the workmen and molders. Also, rats have a great liking for this material, and will often chew up the patterns to obtain the tallow. However, tallow gives a better molding surface for sand than black fuel oil.

A cheap grade of vaseline has been used on patterns for molding cast-concrete blocks in sand. This is safe and pleasant to handle; it gives a good surface, and, of course, will not attract rats, but it does not harden the surface of the wood any more than the black oil or the tallow.

Resin Coating

Common yellow resin, dissolved in benzine or one of the cheap turpentine substitutes, gives a smooth, hard surface, resists moisture, lasts well, although not so well as shellac or some of the other coatings, and is much cheaper than shellac. This coating often proves very satisfactory.

Paraffin wax, dissolved by a gentle heat in benzine, turpentine or turpentine substitute, or gasoline, is very cheap, easy to apply, and gives a particularly smooth surface for molding the sand. This coating resists moisture very well and has given satisfaction, but, of course, it does not harden the grain of the wood like shellac, nor does it raise the grain of the wood. Water-glass or silicate of soda and potash is cheap, almost insoluble in water after once setting, and so may be said to be waterproof. It gives a hard smooth surface, although in some cases it will raise the grain a little. This trouble is largely overcome by making the coating as thick as is convenient to spread with a brush.

Glue Body Coatings

Very hot glue, made of "hard horn and hoof" stock, gives a hard resisting surface which is smooth and strong. It may raise the grain a little, however, when put on, and if not further protected, will become sticky in damp weather. Rats also have a liking for this material, and may eat out parts of the patterns coated with it.

If the patterns are first given a coat of thin, very hot glue, and after that is cold and hard, a coat of water-glass, a coating having the strength and hardness of glue and the smoothness and moisture-resisting qualities of water-glass is obtained. As the water-glass will soften and bite into the glue just enough to hold well before it dries, a coating of this kind proves very serviceable. Adding one-half ounce of carbolic acid to a quart of melted liquid glue is beneficial, and rubbing down the hard cold glue with pumice stone powder before applying the coat of water-glass gives a fine finish. Colors may, of course, be added as desired either to the glue or the water-glass or both.

Casein varnish made from the so-called "waterproof casein glue powder" gives a very smooth and satisfactory finish. One coat is often sufficient, but a finish coat of water-glass may be applied after the casein varnish is dry. On rather open and porous grained wood, where the cost prohibits using more than one coat, a coating material made of about equal parts of casein glue varnish and rather thin water-glass can be used with excellent results. Both the casein and water-glass are cheap and durable and do not attract rats or vermin.

It should not be assumed from the foregoing that the last-named coating is the best; in some cases it may be the most satisfactory, but all the coatings described are useful in large as well as small plants for certain purposes.

* * *

The American Association of Engineers, 63 E. Adams St., Chicago, Ill., which is engaged in furthering the economic interests of the engineering profession, has developed plans for unemployment insurance for professional engineers.

MATTHEW J. O'NEILL

With the passing of Matthew J. O'Neill, who died at his home in New York of heart disease on February 3, the technical publishing field lost a man who had made his mark in one of its most exacting branches.

Mr. O'Neill was born in Brooklyn, July 29, 1872, and all his fifty-five years were passed here. His education was obtained in the New York public schools and in the College of the Jesuit Fathers, where he acquired a capacity for clear thinking and writing and an appreciation of the best in literature, that he continued to cultivate all through his busy life. Mr. O'Neill acquired nearly all his business experience with The Industrial Press, publishers of MACHINERY, his connection with this company beginning in 1898 and extending over twenty-six years, during which period his business ability and untiring energy were invaluable to the company. He held various positions in this organization, eventually becoming treasurer and general manager, resigning in 1924 for the purpose of establishing a business of his own, having bought *The American Printer* which he owned at the time of his death.

Mr. O'Neill had a keen interest in life and possessed a personality that made friends and held them, many of the closest friendships that he left being in the organization with which he was so long connected.

Mr. O'Neill is survived by his wife and one daughter.

PERSONALS

C. W. LIGHTHALL, who has been factory manager of the Hoover Steel Ball Co., Ann Arbor, Mich., since its formation, has been promoted to the position of general manager, filling the vacancy caused by the resignation of H. D. RUNCIMAN. Mr. Lighthall will continue to serve as a member of the board of directors.

S. G. MORRIS, formerly connected with the Bourne-Fuller Co. as assistant purchasing agent, is now associated with the Cleveland Duplex Machinery Co., Inc., in the capacity of sales engineer, covering the northeastern Ohio territory. Mr. Morris is experienced in the installation of nut, bolt, and rivet manufacturing equipment.

HARRY E. MILLER has been appointed works manager of the Newark plant of the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Mr. Miller became connected with the Westinghouse organization in 1889, and has been with the Newark plant since 1900, having served as assistant superintendent, superintendent, and assistant works manager.

REDFIELD H. ALLEN, of the Worthington Pump & Machinery Corporation, East Cambridge, Mass., has been presented with the 1926 S. Obermayer prize, which is awarded annually for the best idea for a foundry method or device. Competing devices are submitted in the form of models or drawings, and are displayed at the annual conventions of the American Foundrymen's Association.

W. C. STETTINIUS, president of the American Hammered Piston Ring Co. of Baltimore, Md., has been appointed a member of the merchandising committee of the Automotive Equipment Association, filling the vacancy caused by the resignation of T. H. QUINN of the National Lamp Works of the General Electric Co. Mr. Stettinius is president of the National Society of Purchasing Agents, having been elected to that office at the association's meeting last November.

LAWRENCE WOOD has been appointed general sales manager of the Colonial Steel Co., Pittsburg, Pa. Mr. Wood entered the employ of the company as a clerk in the sales department in 1912, and has been connected with the organization continuously since that time, with the exception of thirteen months, between December, 1917, and January, 1919, when he served in the Ordnance Corps of the United States Army. He has held the positions of district manager of sales in Pittsburg, district manager of sales in Detroit, and assistant sales manager.

EDWIN H. PEIRCE, of Worcester, Mass., has been made vice-president and general manager of the Niles Tool Works Co. at Hamilton, Ohio—a division of the Niles-Bement-Pond Co.—and will be assistant to James K. Cullen, president of the company. For the last nineteen years, Mr. Peirce has been active in the American Steel & Wire Co. of the United States Steel Corporation. He was superintendent of the New Haven Works of the company for about six years, during which time large extensions to the plant were made. For the last two years he has been superintendent of the South Works, Worcester, Mass., the largest works of the American Steel & Wire Co.

LAWRENCE W. WALLACE, executive secretary of the American Engineering Council, has been re-elected president of the Eyesight Conservation Council of America for 1927. Mr. Wallace was also chosen a member of the board of directors for a three-year term. GUY A. HENRY was again made general director. Elections to the board of councilors include JAMES J. DAVIS, Secretary of Labor; Dr. ARTHUR L. DAY, director of the Geophysical Laboratories of the Carnegie Institution of Washington; Professor JOSEPH W. ROE, head of the Department of Industrial Engineering, New York University. The Eyesight Conservation Council has won unquestioned recognition as an authoritative source of information on all phases of eye conservation.

H. O. K. MEISTER has been appointed general sales manager of the Hyatt Roller Bearing Co., Newark, N. J., and A. W. SCARRATT, chief engineer. Mr. Meister joined the Hyatt forces more than fourteen years ago, serving first as an engineer at the home office in Newark. Later he was transferred to the Chicago office where, after a few years, he took over the supervision of Hyatt sales work in the western territory. Eighteen months ago, Mr. Meister was appointed assistant sales manager, which position he has held until his present promotion to general sales manager. He will continue to make the Newark office his headquarters. Mr. Scarratt joined the Hyatt engineering staff a few months ago as assistant chief engineer. He will also be located at Newark.

J. H. HUNT, of the General Motors Corporation Research Laboratories, has been elected president of the Society of Automotive Engineers. Mr. Hunt was born in 1882, graduated from the University of Michigan in 1905 in electrical engineering, and then went with the Western Electric Co. Later he engaged in educational work, spending one year in the electrical engineering department of the Washington University and five years at the Ohio State University. In 1912 he entered the engineering department of the Packard Motor Car Co., and in 1913 became research engineer for the Dayton Engineering Laboratories. Since 1920 he has been head of the electrical division of the General Motors Research Corporation and the General Motors Corporation Research Laboratories.

TRADE NOTES

Federal Machinery Sales Co. has moved from 12 N. Jefferson St., Chicago, Ill., to 17 S. Jefferson St. The company occupies the entire first floor, which is about 77 feet wide by 177 feet deep.

Brown Instrument Co., 4418 Wayne Ave., Philadelphia, Pa., announces the opening of a Buffalo branch at 794 Ellicott Square Bldg., Buffalo, N. Y. D. C. Mayne is district manager of the Buffalo branch.

Oil Jack Co., Inc., manufacturer of the Pedersen "Oiljak," which is made in two sizes, one with a capacity up to 3 tons and one up to 10 tons, announces the removal of the general offices of the company to 15 Park Row, New York City.

Variety Machine & Stamping Co. has moved into its new plant at 3404-3408 Tate Ave., Cleveland, Ohio, which has a floor space of approximately 2000 square feet. New equipment has been added, and the firm announces that it is now in a position to handle all kinds of stampings.

Hill Clutch, Machine & Foundry Co., Cleveland, Ohio, has appointed Charles C. Phelps, 473 Getty Ave., Paterson, N. J., sales engineer for the Metropolitan New York and northern New Jersey district. Mr. Phelps will handle the company's complete line of power transmission equipment.

National-Harris Wire Co., 605 N. 3rd St., Newark, N. J., announces the consolidation, by purchase, of the Harris Alloys, Inc., the National Alloyed Metals Co., and the Murray-Harris Wire Co., the business of these three companies now being conducted under the name of the National-Harris Wire Co.

Arthur Jackson Machine Tool Co., Toronto, Canada, moved into its new office at 32-34 Front St., W., Toronto 2, on March 1. This firm specializes in mass production machine tools, welding machines, threading equipment, stop watches, etc., and represents a number of United States machine tool manufacturers in Canada.

Hyatt Roller Bearing Co., Newark, N. J., announces that the Pittsburg offices of the company, recently made headquarters for the central sales division, have been moved from 1352 Union Trust Building to 806 Fulton Building, Pittsburg. B. H. Lytle is in charge of the central division. H. R. London has joined the Pittsburg sales force.

Botfield Refractories Co., Philadelphia, Pa., has recently appointed the following concerns distributors for "Adamant" firebrick cement: Southern Steel & Cement Co., Asheville, N. C.; Henry A. Petter Supply Co., Paducah, Ky.; Columbia Supply Co., 823 W. Gervais St., Columbia, S. C.; and Spartanburg Mill Supply Co., 218 Ezell St., Spartanburg, S. C.

Hamilton Tool Co., Inc., Hamilton, Ohio, has purchased the patents, drawings, patterns, jigs, tools, and fixtures, good will, etc., of the Hamilton Machine Tool Co., and will continue the manufacture of the Hamilton rapid-production lathes and heavy-duty planers. The company will be in a position to furnish replacement parts for Hamilton machines.

Colt's Patent Fire Arms Mfg. Co., Hartford, Conn., has taken over the "No-Dust" cleaning, rinsing, and drying machines heretofore manufactured by the No-Dust Drying Machine Co. Division of Blake & Johnson Co., Waterbury, Conn. The machine will be manufactured in the future under the name of the Colt "Autosan" metal parts cleaning machine, revolving type.

Gisholt Machine Co., Madison, Wis., has recently opened an office at 722 W. Washington Blvd., Chicago, Ill., in charge of R. E. MacCartney, who has been special factory representative of the company in the Chicago district for the last year. Mr. MacCartney will be assisted by E. B. Verner. A representative of the service department will also be included in the Chicago organization.

Cleveland Planer Co., 3148 Superior Ave., Cleveland, Ohio, has taken over the manufacture of the Woodward 24-inch and 36-inch crank planers formerly built by the Woodward & Powell Co., Worcester, Mass. These machines will be manufactured in connection with the company's regular line of Cleveland open-side planers. Repair parts, as well as the manufacture of new machines, will be taken care of.

Williamsport Wire Rope Co., Williamsport, Pa., has been reorganized with the purchase of the Cochran interests by a syndicate headed by Robert Gilmore, Edgar Munson, Logan Cunningham, and C. M. Ballard. Mr. Gilmore, who has been associated with the company for thirty-four years, continues to serve as president; Mr. Munson is vice-president and treasurer; Mr. Cunningham, vice-president and secretary; and Mr. Ballard, vice-president and general sales manager. Plans are being made for the erection of a large new plant.

Cincinnati Bickford Tool Co., Oakley, Cincinnati, Ohio, announces, through its attorneys, Nathan & Bowman, New York City, that suit for infringement of several United States patents and of a trademark has been brought by the Cincinnati Bickford Tool Co. against Morey & Co., Inc., as importer of radial drills manufactured in Germany. The complaint alleges that the foreign made machine is a close copy of the plaintiff's drill, and that the trade name "Bickford" is used to convey the impression to the purchaser that the machine is the same as that produced by the plaintiff.

Relay Motors Corporation, Wabash, Ind., has recently been incorporated to take over all assets of the Commerce Motor Truck Co., Ypsilanti, Mich., and the Service Motors, Inc., Wabash, Ind. The officers of the new company are G. L. Gillam, president; M. A. Holmes, vice-president; A. K. Taber, secretary and treasurer. W. R. Bassick is chairman of the board of directors. Mr. Bassick was formerly vice-president of the Bassick Co. Mr. Gillam has been president of the Service Motors, Inc., since 1923, and has been identified with the truck industry for many years. Mr. Holmes, who will be in charge of all sales, was director of sales for the Commerce Motor Truck Co., and also vice-president and sales manager of the Republic Motor Truck Co. Mr. Taber was formerly treasurer of the Service Motors, Inc.

R. Y. Ferner Co., Investment Bldg., Washington, D. C., sole agents in the United States and Canada of the Société Genevoise d'Instruments de Physique, of Geneva, Switzerland, maker of machine tools, measuring apparatus, and scientific equipment, announces the appointment of three agents for the territories indicated, in the sale of the industrial equipment made by the Société Genevoise. Neff Kohlbusch & Bissell, Inc., 806 W. Washington Blvd., Chicago, will cover northern Illinois, eastern Iowa, and the counties of Lake, Porter, LaPorte, St. Joseph, and Elkhart in Indiana. The Badger-Packard Machinery Co., 133 W. Water St., Milwaukee, will cover Wisconsin. Joseph C. Fletcher, 770 Folsom St., San Francisco, has been assigned the Pacific Coast territory. In addition, the territory of the Walter S. Ryan Co., General Motors Building, Detroit, has been extended to cover the remainder of Indiana not included in the Chicago territory. The Walter S. Ryan Co. office will also handle the Canadian territory.

COMING EVENTS

APRIL 4-6—Regional meeting, American Society of Mechanical Engineers in Kansas City, Mo. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

APRIL 25-26—Annual convention of the National Metal Trades Association at Hotel Statler, Detroit, Mich. J. E. Nyhan, secretary, People's Gas Building, Chicago, Ill.

APRIL 27-29—Annual meeting of the American Welding Society at the Engineering Societies Building, 29 W. 39th St., New York City. M. M. Kelly, secretary, 29 W. 39th St., New York City.

MAY 19-20—Spring sectional meeting of the American Society for Steel Treating in Milwaukee, Wis. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

MAY 23-26—Spring meeting of the American Society of Mechanical Engineers at White Sulphur Springs, W. Va., with headquarters at the Greenbrier Hotel. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 25-27—Annual meeting of the Society of Industrial Engineers at Hotel Stevens, Chicago, Ill. George C. Dent, secretary, 608 S. Dearborn St., Chicago, Ill.

MAY 25-27—National Foreign Trade Council convention at Detroit, Mich. O. K. Davis, secretary, 1 Hanover Square, New York City.

MAY 25-28—Spring meeting of the Society of Automotive Engineers at French Lick Springs, Ind. Coker F. Clarkson, 29 W. 39th St., New York City, secretary.

JUNE 6-9—Annual convention of the American Foundrymen's Association to be held at Edgewater Beach Hotel, Chicago. No exhibition of equipment will be held this year in conjunction with the convention. C. E. Hoyt, executive secretary, 140 S. Dearborn St., Chicago, Ill.

JUNE 7-9—Annual meeting of the Mechanical Division of the American Railway Association at Windsor Hotel, Montreal, Quebec. There will be no exhibits of railway appliances or machinery this year. V. R. Hawthorne, secretary, 431 S. Dearborn St., Chicago, Ill.

JUNE 13-17—Twenty-second annual convention of the National Supply and Machinery Dis-

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tributors' Association in conjunction with the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association, on board the Steamship *Noronic*, leaving Detroit June 13 and returning June 17. George A. Fernley, secretary, 505 Arch St., Philadelphia, Pa.

JUNE 20-24—Annual meeting of the American Society for Testing Materials at French Lick Springs, Ind. Secretary's address, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

AUGUST 31-SEPTEMBER 2—Annual convention of the American Railway Tool Foremen's Association at the Hotel Sherman, Chicago, Ill. G. G. Macina, secretary, 11402 Calumet Ave., Chicago, Ill.

SEPTEMBER 7-9—Seventh annual New Haven machine tool exhibition to be held in New Haven, Conn. Harry R. Westcott, Chairman Exhibition Committee, 400 Temple St., New Haven, Conn.

SEPTEMBER 19-23—National Machine Tool Builders' Association Exposition to be held in Cleveland, Ohio, under the direction of the association. For further information, address National Machine Tool Builders' Exposition Manager, Room 635, 1328 Broadway, New York City.

SEPTEMBER 19-23—Ninth annual convention and exposition of the American Society for Steel Treating to be held in Convention Hall, Detroit, Mich. For further information, address W. H. Eisenman, National Secretary, 4600 Prospect Ave., Cleveland, Ohio.

SEPTEMBER 26-OCTOBER 1—Eleventh annual exposition of chemical industries in the Grand Central Palace, New York City. For further information address Publicity Department, Exposition of Chemical Industries, Grand Central Palace, New York, N. Y.

NEW BOOKS AND PAMPHLETS

ELIMINATION OF WASTE-STEEL SPIRAL RODS FOR CONCRETE REINFORCEMENT. 12 pages, 6 by 9 inches. Published by the Department of Commerce, Washington, D. C., as Simplified Practice Recommendation No. 53 of the Bureau of Standards. Price, 5 cents.

AN INVESTIGATION OF TWIST DRILLS—Part II. By Bruce W. Benedict and Albert E. Hershey. 76 pages, 6 by 9 inches. Published by the University of Illinois, Urbana, Ill., as Bulletin No. 159 of the Engineering Experiment Station. Price, 40 cents.

SHIP MODEL MAKING. By Captain E. Armitage McCann. 150 pages, 6 by 9 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $2.50, net.

This is the second volume of a work on ship model making, the first volume of which dealt with the making of Spanish galleons and pirate ships. The present volume contains instructions for making the model of an American clipper ship. A third volume will be published subsequently on methods of making a model of the U. S. S. *Constitution*.

THE DAWSON LITTLE RED BOOK (1926-1927). 128 pages, 3¼ by 5½ inches. Published by William Dawson & Sons, Ltd., Cannon House, Breams Buildings, London, E.C. 4, England.

This is the thirty-third edition of an annual guide to newspapers and magazines. It contains over 5000 of the chief publications of the world, including British, American, Belgian, Canadian, Chinese and Japanese, Dutch, French, German and Austrian, Italian, Norwegian, Swedish, Russian, Spanish and Portuguese, and Swiss periodicals. The list gives the city and country in which the magazine is located and the subscription rate in English money.

MECHANICAL WORLD ELECTRICAL POCKET BOOK (1927) 338 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 65 King St., Manchester, England. Price, 1/6, net.

This is the twentieth edition of this well-known little electrical pocket book, which contains a collection of electrical engineering notes, rules, tables, and data. Various new features have been included in the present edition, among which may be mentioned a section on alternating-current commutator motors. Another section deals with time switches, and another with electric signs, flashers, and dimmers. There is a new section on electric pumping, giving information of value in selecting motors for driving piston and centrifugal pumps. The text throughout has been revised where necessary, and many new illustrations have been introduced.

NEW CATALOGUES AND CIRCULARS

SPRING COILING MACHINES. Sleeper & Hartley, Inc., Worcester, Mass. Wall chart containing a table of standard wire gage.

CUPOLAS. J. W. Paxson Co., Philadelphia, Pa. Bulletin 41, illustrating and describing the various styles of Paxson-Colliau cupolas.

CUPOLAS. Northern Engineering Works, Detroit, Mich. Catalogue N-101, containing general specifications covering the line of Newten cupolas.

CUPOLAS. Whiting Corporation, Harvey, Ill. Catalogue 201, descriptive of the features of construction of the Whiting cupola, and giving standard sizes and capacities.

PROTRACTOR TRIANGLES. E. S. Brown, 247 W. Genesee St., Auburn, N. Y. Circular illustrating and describing the "Facila" universal adjustable protractor triangle.

WELDING EQUIPMENT. Air Reduction Sales Co., 342 Madison Ave., New York City. Catalogue Section No. 6, on Airco-Davis-Bournonville oxygen manifolds for oxygen cylinders.

AUTOMOBILE REFINISHING. Narco Inc., Elm St. and Andrews Lane, North Tarrytown, N. Y. Circular descriptive of the process of automobile refinishing as carried out at this plant.

RIVETERS. Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill. Bulletin R-206, describing the operating characteristics of Hanna pneumatic riveters, and illustrating various styles and sizes.

CAP- AND SET-SCREWS. Bristol Co., Waterbury, Conn. Bulletin 819, containing data on "Bristo" hollow safety set-screws and cap-screws. Dimensions and list prices are given for the standard sizes.

SPEED REDUCERS. William E. Simpson, 100 Morgan Bldg., Detroit, Mich. Circular illustrating and describing variable-speed reduction units adapted for all applications where a variation of speed is necessary.

BALL BEARINGS. New Departure Mfg. Co., Bristol, Conn. Sheets 174 FE and 175 FE for loose-leaf binder, descriptive of installations of ball bearings in chipping or scaling tools and portable electric hand saws, respectively.

WIRE FORMING MACHINERY. Baird Machine Co., Bridgeport, Conn. Circular illustrating Baird wire forming machines, automatic power presses for small stamping work, tumbling barrels, and spring-making machines.

MATERIAL HANDLING EQUIPMENT. Henry B. Newhall Corporation, New Jersey Foundry & Machine Co. Division, Garwood, N. J. Circular illustrating the use of "Delta" portable elevators and cranes on a variety of work.

LUBRICATION SYSTEMS. Bowen Products Corporation, Auburn, N. Y. Pamphlet descriptive of the Bowen system of lubrication for industrial machinery. Pamphlet containing parts and price list for the Bowen system of lubrication.

HARDENING EQUIPMENT. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Circular entitled "Hardening Without Change in Dimensions," containing information on the hardening of forming punches, dies, and molds by the Hump method.

WORK-BENCHES. Standard Pressed Steel Co., Box 20, Jenkintown, Pa. Circular illustrating and describing the Hallowell line of steel work-benches and steel factory equipment. List prices, dimensions, and weights are given for the various sizes and styles.

CHUCKS. Apex Machine Co., Dayton, Ohio, (sales agent, Commercial Tool Co., 2026 E. 22nd St., Cleveland, Ohio). Bulletin 8A, containing data on "Apex" friction drive drilling and tapping chucks. Dimensions and prices of the various types are included.

MILLING MACHINES. Kearney & Trecker Corporation, Milwaukee, Wis. Lay-out No. 22, illustrating the milling of pads on motor frame saddles by the use of a rotary table fixture equipped with a "Mill-Skip" feed. Complete specifications concerning the job are given.

ELECTRICAL EQUIPMENT AND ACCESSORIES. Hobart Bros. Co., Troy, Ohio. Bulletins illustrating HB constant potential battery chargers; portable "trouble shooters" for testing generators, batteries, and other units of an electrical system; air compressors; and test benches.

SYKES GEARS. Farrel Foundry & Machine Co., Buffalo, N. Y. Catalogue of Sykes double helical gears with continuous teeth. Several examples of gear units designed for various applications are illustrated. Tables and charts of technical data relating to the general subject of gearing are included.

ARC WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Circular GEA-569, illustrating and describing constant-potential arc welding sets. Leaflet GEA-571, illustrating and describing arc welding accessories, including hand shields and helmets, electrode holders, welding reactors, cable, etc.

HEAT-TREATING EQUIPMENT. Stanley P. Rockwell Co., 66 Trumbull St., Hartford, Conn. Bulletin 2701, descriptive of the Rockwell dilatometer for laboratory research in determining critical points or transformation ranges of steel, brass, aluminum, and other alloys, or for measuring the thermal expansion of materials.

WRENCHES. Husky Wrench Co., Milwaukee, Wis. Catalogue of the Husky "Common Sense" line of socket wrenches, illustrating and giving prices of the various styles. Pamphlet containing information on the development of socket wrenches, the construction of present types, and other data of interest to those using tools of this kind.

SPEED REDUCERS. Boston Gear Works Sales Co., Norfolk Downs, Mass. Booklet C1-27, containing data on the line of standardized speed reducing units made by this concern, which are stocked for immediate delivery in sizes of from 1 to 25 horsepower, with ratios up to 400 to 1. Specifications, including prices, are given for the various types and sizes.

CUTTING LUBRICANTS. Sun Oil Co., Philadelphia, Pa. Pamphlet entitled "Cutting and Grinding Facts," containing information on the application of "Sunoco" emulsifying cutting oil. The pamphlet contains illustrations and descriptions of a variety of actual operations on which this cutting lubricant has been used, and gives the correct proportions for each case.

FORGING HAMMERS. Nazel Engineering & Machine Works, 4043 N. 5th St., Philadelphia, Pa. Booklet entitled "Cutting Forging Costs," showing a number of views of the Nazel hammer at work in various lines of forging in different industries. A copy of the bulletin and also copies of the Nazel hammer book or Nielson performance surveys will be sent to those interested, upon request.

GRINDING MACHINES. Cincinnati Grinders, Inc., Cincinnati, Ohio. Catalogue entitled "Cincinnati Grinders for Locomotive Work." The booklet calls attention to the fact that these machines are equipped to grind locomotive axles for the Timken tapered roller bearings. Other applications of the machine in the railroad shop are illustrated, and complete specifications of the various sizes are given.